The EDISON ELECTRIC INSTITUTE BULLETIN

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February 1955

Published Monthly by Edison Electric Institute

Sales Conference Program

Distribution Engineers' Problems With Room Air Conditioners

W. M. Penney and V. J. Farmer

Hydro in New England

C. W. Mayott

Portable Transcriber For Meter Reading

Kenneth E. Iverson

Progress Report on Chemical Heat Storage

ELECTRICAL RESEARCH STATISTICS
THE ELECTRIC LIGHT AND POWER INDUSTRY

Current Statistical Data Covering 100 Per Cent of Industry

November, 1953-1954

SOURCE AND DISPOSAL OF ENERGY—MONTH OF NOVEMBER

	1954	1953	%
NET GENERATION* (Kwhrs in Thousands)			
By Fuel Burning Plants	32,101,029	29,453,769	+ 9.0
By Water Power Plants	8,116,238	6,975,368	+16.4
Total Generation	**40,217,267**	**36,429,137**	**+10.4**
Add—Net Imports Over International Boundaries	240,320	68,778	.....
Less—Company Use	124,451	130,565	− 4.7
Less—Energy Used by Producer	612,049	552,490	+10.8
Net Energy for Distribution	**39,721,087**	**35,814,860**	**+10.9**
Lost and Unaccounted for	4,328,636	3,895,740	+11.1
Sales to Ultimate Customers	**35,392,451**	**31,919,120**	**+10.9**

CLASSIFICATION OF SALES

NUMBER OF CUSTOMERS—As of November 30			
Residential or Domestic	43,038,760	41,885,457	+ 2.8
Rural (Distinct Rural Rates)	1,637,550	1,623,380	+ 0.9
Commercial or Industrial:			
Small Light and Power	5,993,387	5,852,728	+ 2.4
Large Light and Power	280,574	273,094	+ 2.7
Other Customers	164,348	160,372	+ 2.5
Total Ultimate Customers	**51,114,619**	**49,795,031**	**+ 2.7**
KILOWATTHOUR SALES—During Month of November (Kwhrs in Thousands)			
Residential or Domestic	9,200,021	8,253,064	+11.5
Rural (Distinct Rural Rates)	720,449	645,278	+11.6
Commercial or Industrial:			
Small Light and Power	6,263,701	5,779,617	+ 8.4
Large Light and Power	17,571,213	15,668,499	+12.1
Street and Highway Lighting	389,255	367,303	+ 6.0
Other Public Authorities	812,819	761,276	+ 6.8
Railways and Railroads:			
Street and Interurban Railways	213,918	227,686	− 6.1
Electrified Railroads	171,642	173,312	− 1.0
Interdepartmental	49,432	43,085	+14.7
Total to Ultimate Customers	**35,392,450**	**31,919,120**	**+10.9**
Revenue from Ultimate Customers (Thousands)	**$620,306**	**$571,296**	**+ 8.6**

RESIDENTIAL OR DOMESTIC SERVICE

AVERAGE CUSTOMER DATA—For 12 months ended November 30, 1954			
Kilowatthours per Customer	2,528	2,332	+ 8.4
Average Annual Bill	$68.26	$63.90	+ 6.8
Revenue per Kilowatthour	2.70¢	2.74¢	− 1.5

* By Courtesy of the Federal Power Commission.

THE EDISON ELECTRIC INSTITUTE BULLETIN is published monthly by the Edison Electric Institute, an association of electric light and power companies in the United States and its territorial possessions. Its affiliate members consist of members of the Canadian Electrical Association.

The objectives of the Edison Electric Institute are:

The advancement in the public service of the art of producing, transmitting, and distributing electricity and the promotion of scientific research in such field.

The ascertainment and making available to the members and the public of factual information, data, and statistics relating to the electric industry.

To aid its operating company members to generate and sell electric energy at the lowest possible price commensurate with safe and adequate service, giving due regard to the interests of consumer, investor, and employee.

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CONVENTIONS AND MEETINGS

1955

FEBRUARY

15-16 EEI-AGA Depreciation Accounting Committees, Palmer House, Chicago, Ill.
15-16 PEA Relay Committee, Hotel Roosevelt, Pittsburgh, Pa.
15-16 EEI-AGA Plant Accounting and Property Records Committee, Edgewater Beach Hotel, Chicago, Ill.
17-18 EEI Commercial Electric Space Heating and Air Conditioning Committee, Terrace Plaza Hotel, Cincinnati, Ohio
17-18 EEI-AGA 1955 Accounting Conference Planning Meeting, Edgewater Beach Hotel, Chicago, Ill.
17-18 PEA Electrical Equipment Committee, Benjamin Franklin Hotel, Philadelphia, Pa.
20-21 EEI Residential Promotion Committee, EEI Headquarters, New York, N. Y.
23-24 Pacific Coast Electrical Association Conference on Electronic Integrated Data Processing, Hotel Statler, Los Angeles, Calif.
24-25 PEA Systems Operation Committee, Abraham Lincoln Hotel, Reading, Pa.
24-25 11th Annual National Adequate Wiring Conference, La Salle Hotel, Chicago, Ill.

MARCH

1- 2 ASME 1st International Congress on Air Pollution, Hotel Statler, N.Y.C.
3- 4 Street Tree and Utility Conference, sponsored by EEI Transmission & Distribution Committee, IES Street Lighting Committee, and National Shade Tree Conference, Shade Tree Selection Committee, Wade-Park Manor Hotel, Cleveland, Ohio.
6- 9 North Central Electric Association, Sales Committee Meeting, Radisson Hotel, Minneapolis, Minn.
7- 8 Pacific Coast Electrical Association Engineering and Operating Section Conference, Hotel Huntington-Sheraton, Pasadena, Calif.
7- 9 Canadian Electrical Association, Meetings of all Sections of Western Zone, Bessborough Hotel, Saskatoon, Sask.
13-18 NEMA, Edgewater Beach Hotel, Chicago, Ill.
16-17 EEI Insurance Committee, Jung Hotel, New Orleans, La.
16 EEI Industrial Relations Committee, Sheraton Park Hotel, Washington, D. C.
18-20 ASME Spring Meeting, Lord Baltimore Hotel, Baltimore, Md.
21-23 Southeastern Electric Exchange, Annual Meeting, Boca Raton Hotel and Club, Boca Raton, Fla.
23-25 Missouri Valley Electric Association, Engineering Conference, President Hotel, Kansas City, Mo.
24-25 Oklahoma Utilities Association Convention, Mayo Hotel, Tulsa, Okla.
28-31 21st Annual EEI Sales Conference, Edgewater Beach Hotel, Chicago, Ill.
30-Apr. 1—American Power Conference, Chicago, Ill.

APRIL

6- 7 15th Annual Young Men's Utility Conference, Ipalco Hall, Indianapolis, Ind.
7- 8 Pacific Coast Electrical Association Joint Conference, Administrative Services and Accounting Section, PCGA, Jokake Inn, Phoenix, Ariz.
7- 8 Southeastern Electric Exchange Engineering and Operating Section, Roosevelt Hotel, New Orleans, La.
12-15 14th Joint AGA-EEI Conference on Operation of Public Utility Motor Vehicles (in conjunction with AGA Distribution, Motor Vehicles and Corrosion Conf.) Netherlands Plaza Hotel, Cincinnati, Ohio.
13-15 Northwest Electric Light and Power Association, Engineering and Operation Section, Davenport Hotel, Spokane, Wash.
17 Rocky Mountain Electrical League Annual Spring Conference, Shirley Savoy Hotel, Denver, Colo.
18-21 ASME Spring Meeting, Lord Baltimore Hotel, Baltimore, Md.
21 EEI Industrial Relations Committee, EEI Headquarters, New York, N. Y.
24-27 Rocky Mountain Electrical League Spring Conference, Shirley Savoy Hotel, Denver, Colo.
25-26 EEI Hydraulic Power Committee, Atlanta Biltmore Hotel, Atlanta, Ga.
25-27 EEI-AGA 1955 National Conference of Electric and Gas Utility Accountants, Conrad Hilton Hotel, Chicago, Ill.
25-27 EEI Meter and Service Committee, Washington-Duke Hotel, Durham, N. C.
25-28 North Central Electric Association, Engineering Committee, Dyckman Hotel, Minneapolis, Minn.

MAY

3- 4 EEI Transmission and Distribution Committee Meeting, Statler Hotel, Detroit, Mich.
5- 6 Wisconsin Utilities Association Home Service Conference, Edgewater Hotel, Madison, Wis.
8-11 EEI Purchasing and Stores Annual Spring Meeting, Dinkler Tutwiler Hotel, Birmingham, Ala.
9-10 EEI Prime Movers Committee, Biltmore Hotel, Los Angeles, Calif.
9-10 EEI Accident Prevention Committee, Pfister Hotel, Milwaukee, Wis.
9-11 Northwest Electric Light and Power Association, Business Development Section, Hotel Utah, Salt Lake City, Utah.
10 EEI Commercial Electric Cooking Conference, Sheraton Hotel, Chicago, Ill.
11-13 Pacific Coast Electrical Association Annual Convention, Palace Hotel, San Francisco, Calif.
16-17 EEI Electrical Equipment Committee, Rice Hotel, Houston, Texas.
19-20 EEI Industrial Relations Committee jointly with Personnel Administrative Section, Southeastern Electric Exchange, Netherlands Plaza, Cincinnati, Ohio.
19-20 PEA Electrical Equipment Committee Meeting, Hotel Roosevelt, Pittsburgh, Pa.
22-25 National Assocaition of Electrical Distributors 47th Annual Convention, The Conrad Hilton Hotel, Chicago, Ill.
23-24 PEA Annual Accounting Conference, William Penn Hotel, Pittsburgh, Pa.
27-28 North Central Electrical Association, Accounting Committee, Fergus Falls, Minn.

JUNE

5-10 ASME Oil and Gas Power Conference, Statler Hotel, Washington, D. C.
13-16 EEI ANNUAL CONVENTION, Los Angeles, Calif.
22-24 Northwest Electric Light & Power Association Accounting and Business Practice Section, Vancouver Hotel, Vancouver, B. C.
26-29 Michigan Electric Association Annual Convention, Grand Hotel, Mackinac Island, Mich.
27-29 CEA Annual Convention, Hotel Vancouver, Vancouver, B. C.
26-28 Wisconsin Utilities Association Accounting Section, Dell View Hotel, Lake Delton, Wis.

AUGUST

11-12 Southeastern Electric Exchange, Personnel Administration Section, Roanoke Hotel, Roanoke, Va.

The EDISON ELECTRIC INSTITUTE
BULLETIN

"The Year of Greatest Opportunity" Is Theme of 21st EEI Sales Conference

WITH a program designed to underline the electric industry's intensified effort to develop effective sales programs, the 21st Annual EEI Sales Conference will be held at the Edgewater Beach Hotel, Chicago, Ill., on March 28-31. Realizing that in recent years commercial activities, especially sales programs, have assumed a greater stature than ever before in insuring the success of the electric industry in the future, the EEI Commercial Division, directed by O. R. Doerr, Vice President, Pacific Gas and Electric Co., and Chairman of the EEI Commercial Division Executive Committee, has arranged an outstanding conference program whose slogan is *Step Up the Drive in '55—the Year of Greatest Opportunity.*

On Monday, the first day of the conference, an all-day Home Service Conference and individual meetings of the 20 Commercial Division Committees will be held. Four of the division's groups — Commercial Sales, Farm, Industrial Power and Heating and Residential — will hold all-day meetings on Tuesday. Also on Tuesday will be the Farm Luncheon. The general sessions will be held on Wednesday morning and afternoon and Thursday morning and the conference will be concluded with a general luncheon at Thursday noon. On Wednesday the annual PUAA Luncheon will feature as speaker Westinghouse Electric Corp.'s Betty Furness. The Home Service Breakfast will be on Tuesday morning.

General Sessions

Chairman Doerr will preside over the general sessions and will make the opening remarks on Wednesday morning. After outlining the day's agenda he will report on committee activities and accomplishments during the past year and will speak briefly on current projects. He will also devote a portion of his remarks to outlining some of the major sales and promotional problems presently facing the electric industry.

O. R. DOERR
Chairman of the Commercial Division Executive Committee

Harold Quinton, President of the Institute and President of Southern California Edison Co., will speak on "Our Electric Utility Business," presenting the status of the electric industry with special consideration for the sales aspects affecting future growth. Mr. Quinton's talk will include his views on the essentiality of selling and the promotion of load growth through home appliances. Dr. Jules Backman, Professor of Economics at New York University and well-known economic advisor to eastern electric utilities, will present his summary of a business forecast for the next few years in a speech entitled "The Economic Outlook." Particular attention will be given by Dr. Backman to those factors pertinent to the electric industry.

Concluding the Wednesday morning session will be the presentation of the prize awards offered annually through the Institute. Harry Restofski, Chairman of the EEI Prize Awards Committee and Vice President of West Penn Power Co., will announce the 1954 winners of the Laura McCall Awards for home service achievements, the George A. Hughes Awards for electric appliance promotion, the Thomas W. Martin Rural Electrification Award, the More Power to America Awards for achievements in industrial electrification, the Frank Watts Awards for promotion of electrically operated farm equipment, the Planned Lighting Awards and the George Westinghouse Awards for promotion of electric laundry equipment.

The Wednesday afternoon session will begin with a talk by Ralph J. Cordiner, President of General Electric Co., entitled "New Trends Stimulating Electrical Growth," which will outline future developments in the field of electric appliance manufacturing and in the manufacture of all electrical equipment. "Year Round Electric Heating and Air Conditioning and the Heat Pump" will be the title of an address by Philip Sporn, President of American Gas and Electric Service Corp.

Using a wide-angle screen and slides, J. H. Jewell, Vice President of Westinghouse Electric Corp., in a talk entitled "Joint Action Today . . . For More Business Tomorrow!" will present a condensed version of the new "industry story of coordinated opportunity," emphasizing a new approach to adequate wiring. As final speaker at the Wednesday afternoon session, Fred Smith, Vice President in Charge of Operations at the Gruen Watch Co. in Cincinnati, Ohio, will deliver an address on "Selling: A Creative Way to Live."

The first speaker at the Thursday morning session, John Worthman of Fort Wayne, Ind., nationally-known home builder and leader in the NAHB, will talk on "As a Builder Sees It," telling of expected trends in home building and what the electric utility business may do to capitalize on this added residential market. Philip A. Fleger, Chairman of the Board of Duquesne Light Co., will present his views on many aspects dealing with the future of the electric industry in a talk entitled "Let Us Recognize Our Future Problems." There will also be a Lighting Presentation in which facts and figures will show why each of the four new lighting promotions currently offered through the work of EEI Commercial Committees presents the best opportunities for profitable load building. Concluding the session will be J. C. Doyle, Sales and Advertising Manager of Ford Motor Co., who will discuss "Selling Is the Answer."

The general luncheon at Thursday noon will, as in the past, conclude the Sales Conference. The speaker at the luncheon will be William H. Gove, Vice President and Sales Director of E.M.C. Recordings Corp., who was chosen by the National Sales Executives Club as both "Professional Salesman of the Year" and "Sales Promotion Man of the Year." Mr. Gove's talk will be entitled "Why Sell."

Home Service Conference

"Selling Electricity" will be the theme of the Home Service Conference to be held all day Monday. Miss Ruth D. Kruger, Home Service Director, Arizona Public Service Co., will preside over the morning session, which will begin with opening remarks by Mrs. Mildred Lessenich, Chairman of the EEI Home Service Committee. Miss Elizabeth Parker, Home Service Director of Georgia Power Co., will speak on "Selling Electricity to Youth Groups," after which Miss Judith O'Flaherty, Supervisor of Home Economics of Philadelphia Electric Co., will discuss "Selling Electricity to Homemakers *Through Home Calls.*" Mrs. Marguerite Fenner, Director of Home Economics of Pacific Gas and Electric Co., will talk on "Selling Electricity to Homemakers *Through Group Contacts.*" A discussion period with Miss Kruger acting as moderator will conclude the morning session.

Miss Margaret Schneider, Home Service Supervisor, Wheeling Electric Co., will preside over the afternoon session. The first speaker will be J. R. Waters, Residential Promotion Manager of Monongahela Power Co., who will discuss "Selling Electricity *Through Teamwork With Dealers.*" Mrs. Mariquita Dygert, Supervisor of Home Service, The Detroit Edison Co., will talk on "Selling Electricity *Through Teamwork With Builders.*" The final speaker of the day will be Don Willis, Vice President of Arizona Public Service Co., whose talk will be entitled "Responsibilities of Home Service."

At the Home Service Breakfast on Tuesday morning, Mrs. Ruth P. Steinhauser, Director of Public Relations of Community Public Service Co., will speak on "How Do You Sell?"

Commercial Sales Group

A. R. Hampsey, Jr., Chairman of the EEI Commercial Cooking and Water Heating Committee, will preside over the morning session of the Commercial Sales Group meeting on Tuesday. After opening remarks by Robert W. Butts, Chairman of the Commercial Sales Group, Constantine W. Bary, Rate Research Engineer of the Philadelphia Electric Co., will speak on "Load Characteristics of Small Manufacturing and Commercial Customers." David D. Lees, Sales Promotion Specialist, Atlantic City Electric Co., will discuss "How We Did It" and will be followed by a talk entitled "Additional Sales Possibilities in the Food Service Market" which will be delivered by C. E. Sperow, General Commercial Cooking Representative of Ohio Edison Co. The last speaker of the morning will be H. W. Brundage, General Manager of the Weathertron Department of General Electric Co., whose talk is entitled "Relatives or Friends."

Presiding over the afternoon session will be J. C. Murtha, Chairman of the EEI Commercial Electric Space Heating and Air Conditioning Committee. Frank J. Smith, Director of Sales Development, Kawneer Manufacturing Co., will discuss "Putting On a Good Front." Speaking on "Electric Advertising: It's Your Market, Too" will be Irve Pitt, Sales Manager of Bellows Sign Co. R. A. Goeller of Hatzel & Buehler in New York will speak on "Rewiring for Commercial Buildings." Ending the afternoon session will be Edward C. Huerkamp, Manager of the Lighting Sales Department, Westinghouse Electric Corp., who will present "NEMA's Certified Lighting Program."

Farm Group

The morning session of the Farm Group meeting on Tuesday will be presided over by Bud S. Moss, Chairman of the EEI Farm Group. "Advertising Techniques in Farm Sales Promotion" will be the subject of the first speaker, John E. Canfield, Vice President of Wisconsin Power and Light Co. Kenneth Richards, Program Manager of Station WKAR-TV, Michigan State College, will describe the "Use of Television in Farm Electrification Promotion." The last speaker of the morning will be C. H. Leatham, Vice President of Monongahela Power Co., whose topic will be "The Challenge To the Farm Group."

At the Farm Luncheon at noon the speaker will be REA Administrator Ancher Nelsen.

A panel discussion entitled "Are We Meeting the Challenge?" with Chairman Moss as moderator, will highlight the afternoon session. As panelists, J. L. Copeman, Agricultural Counselor, Monongahela Power Co., will speak on agricultural development activities; L. H. Hammond, Manager of Rural Development for New York State Electric & Gas Corp., will speak on sales promotion activities; M. B. Penn, Manager of Rural Sales of the Alabama Power Co., will speak on utilization activities; and A. H. Gray, Jr., Head of Southwestern Gas and Electric Co.'s Rural Development Department, will speak on youth activities.

The meeting will conclude with a premiere showing of the motion picture, "Farm Family American," a 27-minute color film produced by General Electric Co.

Industrial Power and Heating Group

Frank E. Wiatt, Chairman of the EEI Sales Methods and Development Committee, will preside over the Tuesday morning session of the EEI Industrial Power and Heating Group meeting. After opening remarks by G. S. Young, Chairman of the EEI Industrial Power and Heating Group,

(*Continued on page* 60)

The Distribution Engineers' Problems with Room Air Conditioners

By W. M. Penney and V. J. Farmer
Union Electric Company of Missouri

Presented at a meeting of the Transmission and Distribution Committee, EEI, Washington, D. C., Feb. 10-11, 1955

LIKE other utilities in the warmer areas of the United States, the Union Electric Co. of Missouri was faced in recent years, and particularly in 1954, with a sudden upsurge of room air conditioning loads that overburdened portions of its distribution system. The large number of room air conditioning units added, and their unknown location on the lines, posed quite a problem to our distribution engineers in providing sufficient capacity in the right places to supply this load. This situation will continue as the public becomes more conscious of the comforts of air conditioning and the cost of the room units is lowered to more nearly fit the average family's budget. Air conditioners will appear without advance notice on any one of the thousands of isolated secondary supply systems, and steps taken to meet such load additions must effectively include provision for the saturation which can reasonably be anticipated some years in the future. This conclusion, reached as a result of our experience, is developed in this report, beginning with a description of the growth of air conditioning load on our system and its associated problems.

Growth of Air Conditioning Loads and Associated Problems

Prior to 1951 air conditioning load on the Union Electric System was 80,000 kw. Most of this load was located in department stores, office buildings, theaters and various other commercial premises in the downtown St. Louis business district. Downtown St. Louis is supplied principally by a large 120/208-v a-c network system which is replacing a declining direct-current system, but with some major a-c loads which preceded the network on a 4-kv radial system out of Plaza Substation. The predominance of air conditioning load in this area is illustrated by Fig. 1, showing monthly kva peaks of Plaza Substation from 1948 to 1953. This station has had prominent summer peaks since 1938.

A more pronounced summer versus winter peak relationship is shown by Fig. 2 for the 120/208-v network. This network summer peak is perhaps more outstanding than may be found in other cities because some customers who have not installed air conditioning continue to be supplied from the direct-current network system.

Commercial air conditioning load presented no special problems to our distribution engineers other than occasional difficulties with excessive motor starting currents. Usually adequate advance information on the characteristics of customers' equipment could be obtained to enable us to properly re-enforce the distribution system supply.

A few thousand room air conditioners appeared on our lines before 1951, but the pace quickened substantially during 1951 and 1952. Difficulties even then did not reach major proportions, being limited mostly to a customer's problem of inadequate wiring, as the distribution system had sufficient reserve capacity to absorb this relatively small increase in load. It did, however, give us a good

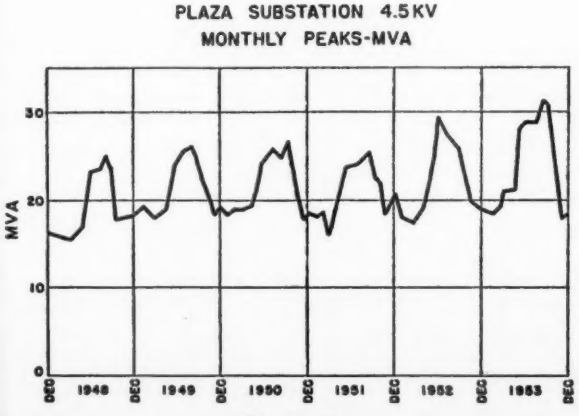


Figure 1

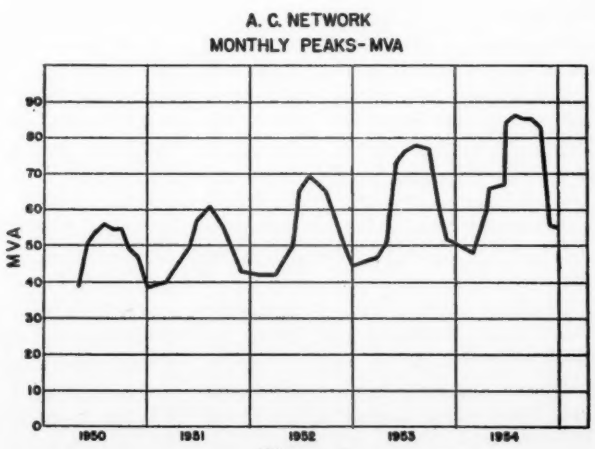


Figure 2

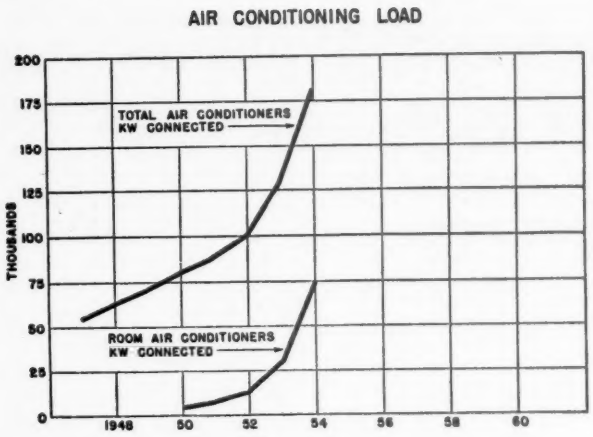


Figure 3

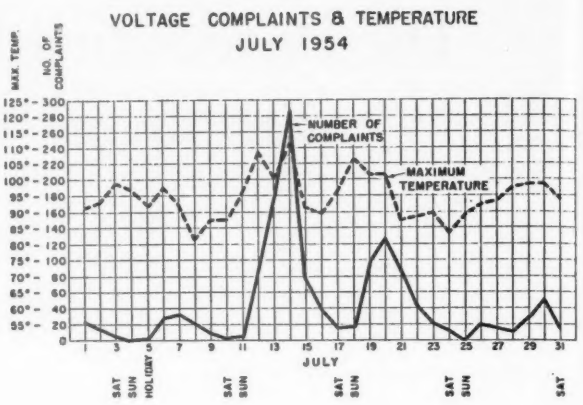


Figure 4

foretaste of what was coming. Considerable thought was given to the problem, especially to the low power factor and high-starting current characteristics of room air conditioners. The possibility of capacity shortages and poor voltage regulation was recognized, and influenced liberalization of our distribution transformer sizing practices and distribution circuit and substation reenforcement programs.

In 1953 a significant upswing of room air conditioner sales occurred, increasing saturation to about four per cent of our residential customers. During June, the hottest month of 1953, voltage complaints rose from a monthly normal of 100 to over 500. Over 300 involved air conditioners. During the same time there were 214 transformer failures and tripouts of completely protected transformers.

The 1953 experience emphasized the problem. In order to compensate for the excessive voltage drop due to the low power factor load, a program was initiated to install 80,000 kvar of switched capacitors on distribution circuits before 1954 summer. For further relief, over 2000 distribution transformers were added or replaced in the St. Louis metropolitan area, and more pressure was put behind substation and feeder construction projects to make ready for 1954 summer.

The low power factor of room air conditioners received our active attention, climaxed by issuance of a notice in January, 1954, to electrical distributors and dealers in the Union Electric area and to air conditioner manufacturers. We announced our intention to apply the low power factor provision of our service rules to air conditioners with power factors below 90 per cent. This announcement attracted wide attention and accelerated discussions between the utility industry and air conditioner manufacturers. The discussions led to an agreement that minimum power factors of 75 per cent for ⅓-ton units, 80 per cent for ½-ton units and 85-per cent for ¾-ton units would be attained for 1956 production, and efforts would be made for further improvement. As a result of this response from manufacturers, Union Electric postponed enforcement of the 90 per cent power factor requirement, pending results of further efforts.

In 1954 the Union Electric System area experienced a record heat wave climaxed by 112.3 degrees on July 14. Room air conditioners and fans were purchased by the thousands and during the peak temperature periods, almost all air conditioners, fans and refrigerators operated nearly 24 hours per day. Approximately 35,000 room air conditioners were sold in the Union Electric area during 1954, bringing the total on our lines to about 60,000 units, rated at 47,000 hp, but actually representing a load of about 75,000 kw. Of course, some of these room air conditioners are in commercial premises, including bulk metered apartments and hotels. Surveys indicate that saturation in single-metered dwellings and apartments is 14.5 per cent in St. Louis County, 6.7 per cent in St. Louis City, and 8.7 per cent over-all, including regional areas. As shown by Fig. 3, total air conditioning load of all types reached 187,000 kw, about 15 per cent of our system native load.

With this large gain in air conditioning units on our lines, voltage complaints and transformer tripouts and failures increased. Fig. 4 shows daily numbers of voltage complaints and daily maximum temperatures during July. Voltage complaints reached 284 during the hottest day, although many of these resulted from excessive voltage drop in the customer wiring. The voltage at the customer's main switch was found deficient in many cases. The low power factor load and unbalance due to the use of 115-v motors were major causes of this situation. Voltage difficulties would have been far less if air conditioning units had been designed for 90 per cent power factor and 230-v operation. During a three-day period, 204 transformers tripped out on overload, and 30 transformers burned out. Total tripouts and burnouts for the full month of July were 347. Fig. 5 shows daily transformer outages and daily temperatures. Note the sharp increase in failures when the temperature exceeds 100 degrees. Had the temperature remained below 100 degrees, failures would have been moderate.

Distribution substations came through this excessive heat wave relatively unscathed. Industrial load on our system was somewhat less and the earlier installation of 80,000 kvar of switched capacitors relieved the substations of considerable reactive load. Nevertheless, there was a decided trend toward summer peak loads on substations which formerly had

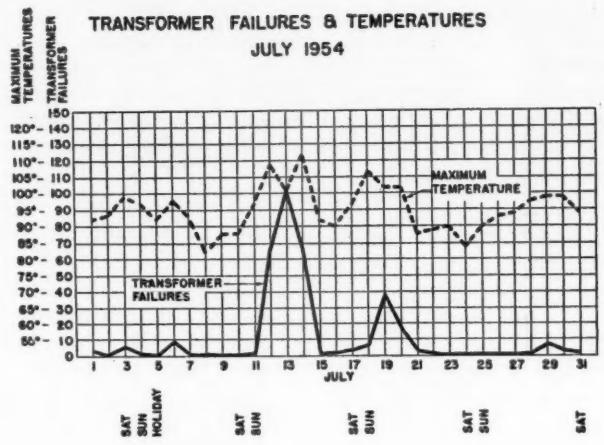


Figure 5

prominent winter peaks. Fig. 6 shows the load on Webster substation which mainly supplies residential customers. In 1951 and 1952, a slight summer upswing can be noticed. In 1953, the summer bulge was much higher. In 1954, it shot up nearly as high as the winter peak load. Since the thermal capability of this substation is 23 per cent higher in winter than in summer, the summer peak represents much heavier thermal loading.

Fig. 7 shows load on a substation serving residential customers and a rapidly developing retailing and office building area. Note the small but growing midsummer bulges in 1949, 1950, and 1951, expanding into summer peaks in 1952, 1953, and 1954. Even though load was removed from this substation in 1953, thereby reducing the winter peak, the 1954 summer peak increased as high as the preceding summer.

Analysis Of The Problem

After the 1954 experience we found ourselves in need of answers not only for the present, but for the future. Before discussing the search for answers, however, some explanations are needed on why we regard this largely as a room air conditioner problem.

The question can be reasonably asked why 47,000 hp of room conditioners can have much effect on a 1,300,000 kw system, especially as this is only 40 per cent of the total air conditioning load. There are several reasons:

1st. *Low Power Factor and Unrealistic Rating*

Room air conditioner compressor motors are customarily loaded much beyond their nominal horsepower rating. In addition air conditioners have one or more auxiliary fan motors. In the past, power factors of the units as a whole have ranged from above 80 per cent to below 60 per cent, averaging between 70 per cent and 75 per cent. Consequently, actual load is at least two kva per hp of rating.

Therefore, this 47,000 hp of room conditioners represents about 100,000 kva connected load, perhaps equal to one-fourth of our residential summer peak load without room conditioners—a much more impressive figure.

2nd. *Lack of Diversity on Peak*

In over 100 degree weather, nearly all room air conditioners will operate continuously day and night. Only if the entire family is on a vacation trip is a unit apt to be turned off, and even then a mother-in-law may move in to get a good night's sleep. Therefore, we may get over 80,000 kva simultaneous load from this 47,000 hp. Furthermore, this will not be a short time peak, but may stay nearly this high for days (and nights) until the hot spell breaks. Transformers, regulators, feeder cables and other apparatus often fail when given no cooling-off period although capable of carrying higher short time peaks without distress.

3rd. *Load Peak at Time of Minimum System Capacity*

The thermal capability of a distribution transformer varies with pre-

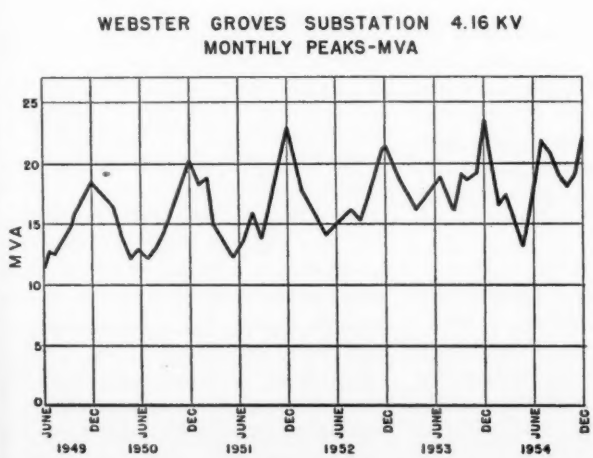


Figure 6

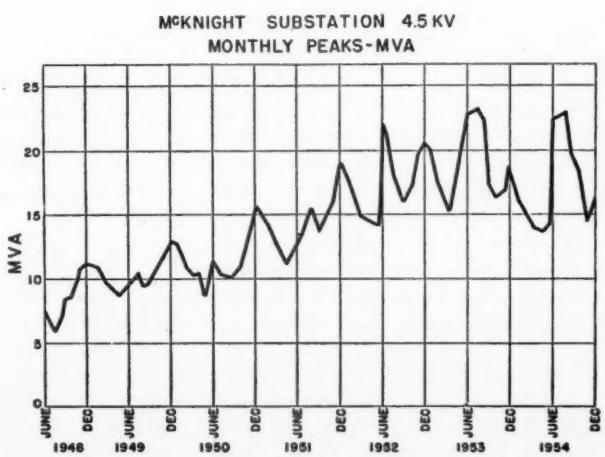


Figure 7

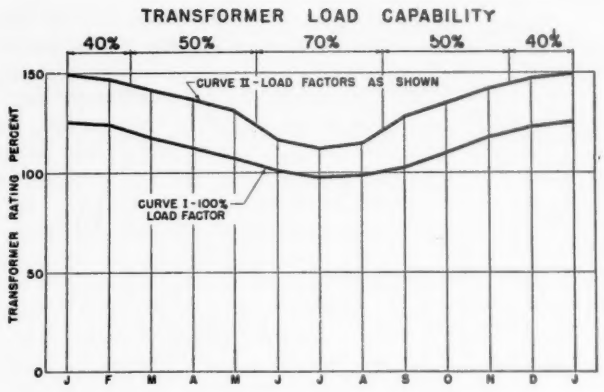


Figure 8

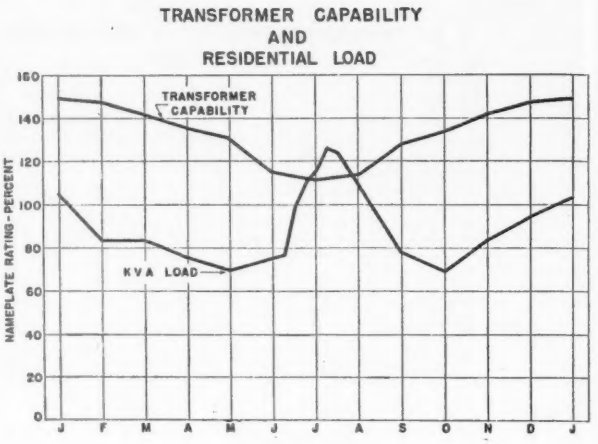


Figure 9

vailing ambient temperature and load factor. Fig. 8, Curve I shows transformer capability at 100 per cent load factor, with five degrees centigrade added to monthly average St. Louis temperatures, as recommended by the American Standards Guide for loading transformers. Curve II is adjusted to represent peak load capability of a transformer supplying residential load with daily load factors of 40 per cent in winter, 70 per cent in summer, and 50 per cent in spring and fall. This results in an even wider difference between summer and winter capability.

In Fig. 9, the top curve is a repetition of the transformer capability curve in Fig. 8. The other curve shows peak kva on a residential transformer on our system which has a high saturation of room air conditioners. Note that the high peak load during the air conditioning season coincides with the minimum transformer capability, resulting in overload, although the transformer has a wide margin of capacity at all other times.

Prior to 1954, this transformer with 40 residential customers had eight room air conditioners with a total rating of five horsepower. Ten units, including a three ton central unit, were added during June and July of 1954 increasing the total to 15 horsepower, although all were not on during the 1954 peak.

4th. *Low Annual Load Factor*

The annual load factor of room air conditioners varies widely, not only between the northern and southern portions of our nation, but also from year to year in a given area with variations in weather. We have little actual data on average annual load factor in the St. Louis area, but believe it to be about 10 per cent. Annual load factors under 4 per cent in more northern areas have been quoted.

The preceding points explain why a utility company frequently must add as much as 2.0 kva capacity to various elements of its distribution system for each horsepower of room air conditioner load, or sustain overloads and subnormal voltage during summer peaks.

Thus, utilities must make tremendous investments to carry room air conditioners which in some areas may provide an annual revenue on less than 1,000 kwhr per horsepower. Obviously, investments must be watched closely to avoid financial loss on this load, or charging customers who do not have air conditioning with excessive rates.

In the past, utilities have been repeatedly confronted with low load factor devices, but by the development and promotion of other appliances and equipment have managed to fill in the valleys of the load curve. This one is going to be tougher than usual.

5th. *Lack of Information*

To the distribution engineer, lack of information is certainly a tough aspect of the room air conditioner problem—not only on where the conditioners are now, but where and how many next week, next year, and five years from now.

For most loads of significant size, including commercial air conditioning, advance information is usually available to the distribution engineer so that capacity additions may be properly planned and constructed. Advance information on room air conditioners is a rarity. Partial information on the number of units sold and where installed might be obtainable, but would be of little value as so many units are sold during the short heat wave that it is impossible to coordinate distribution re-enforcement to meet their demands.

Sales expectations for the year ahead may be halved or doubled by exceptional weather. Distribution planning is further complicated by the fact that the customer after buying one unit, often buys another and influences his neighbor also to buy one. Thus we may find a score of room conditioners on one transformer and only a few on the next.

Search For Solutions

Since the impact of room air conditioners on our lines is particularly felt on the secondaries, the provision of adequate transformer capacity to accommodate this load has been one of the most difficult problems for the distribution engineer.

At first we thought it was essential to locate all existing room air conditioners. Various methods were proposed such as surveys by meter readers, mailing of questionnaires to customers, examination of meter readings to spot large increases in usage during hot weather, and obtaining reports from dealers on air conditioners sold. On further consideration, it was realized that engi-

neering of secondary re-enforcements on the basis of existing room conditioners would not adequately prepare the system for the increase in the following summer's air conditioning sales, and further would be cumulatively rather expensive in man-hours and money.

Our statistics show far more completely protected transformer tripouts than failures of conventional transformers and if the latter had continued to be standard equipment, less customer outages would have resulted. Severe overloads and excessive voltage drops would nevertheless have been present and the advantages of overload protection would have been lost. Furthermore, the red light indicator on completely protected transformers provides a means of discovering overloads by periodic visual inspections.

Revisions Necessary

To minimize customer outages and yet retain the recognized advantages of completely protected transformers, some revision of their tripout settings was necessary. Discussions were held with manufacturers and arrangements made to obtain transformers with the initial trip setting raised to the usual emergency tripout value, and with a new emergency tripout setting at a correspondingly higher level. A procedure was also devised for recalibrating breaker settings to these values on transformers handled by our shops. Signal light settings are, of course, retained at the original value.

This greater margin between signal and tripout will be of some help, but with the sudden appearance of a heat wave, we would be confronted with too many red light indications to properly engineer and execute the needed transformer additions promptly. Also load on some transformers would jump overnight to above the new tripout value. Because of this and the fact that less than half of our transformers are of the completely protected type, the red light indicators cannot be used as a substitute for actual load tests.

Studies were made to determine if a sufficient relationship between kilowatthour monthly usage and peak demand existed to permit an estimate of transformer loading. The climate in St. Louis, however, has been so erratic that a consistent kwhr-kva relationship cannot be established when air conditioning load is involved.

Engineers' Solution

After considering the foregoing methods, our distribution engineers concluded that the best solution is to provide sufficient capacity in the average transformer for at least five years. During that time, estimated normal load growth plus air conditioning as reflected on the summer peak is expected to average one kva per customer. In low income areas, a lower figure of .4 kva per customer is estimated. Transformer re-enforcements will be engineered on the basis of this rate of growth. The procedure will be as follows:

Transformers will be tested with Max-I-Meters, or if recent test results are available, they will be adjusted by adding six per cent growth per year. To this value, we will add one kva per residential customer if the load test was made during hot weather, or 1½ kva per customer if the load test was made during cool weather. In low-income areas, the above growth values are reduced to .4 kva and .6 kva respectively per customer. If the value resulting from the foregoing computation exceeds 110 per cent of the transformer rating, a larger transformer will be installed or the secondary split, and an additional transformer installed. This procedure of matching transformers to the load is expected to result in the installation of 7,000 additional transformers and 2,650 large transformers, totaling 330,000 kva, and is expected to be completed by September 1, 1956.

Conclusions

Our 1954 experience left no question that major efforts are essential to enable our system to carry present and future air conditioning loads. As the first step, we have concentrated our distribution forces as many hours per week as possible on correcting conditions where overload and low voltage had occurred. To provide for the future, an expanded re-enforcement program was undertaken. This included the following:

1. The substation construction program was re-examined for adequacy and timing and rescheduled as necessary to meet future predicted load on the basis of 1954 summer.

2. The heavy program of capacitor installations was extended. After completion of installation of 80,000 kvar by June, 1954, an additional 42,000 kvar was scheduled for the remainder of the year. Installation of 100,000 kvar is planned for 1955. This will bring our system total to 400,000 kvar. A decision has not been reached on how far into the future this heavy capacitor program should be carried but it is believed the installation of a minimum of one kvar for each two kw of general load added will be needed to maintain satisfactorily high power factors on our system.

3. In order to limit the voltage drop on 2,400-v No. 6 wire single phase primary mains, which have been a source of voltage trouble, the transformer kva installed on each main is being examined. Voltage drop will be reduced by limiting transformer capacity on short mains to 200 kva and on long mains to 125 kva.

4. The capacity of distribution secondaries will be increased by installing larger transformers or splitting the secondaries and installing additional transformers in accordance with the formula previously described.

Continuing Program

This program is not a complete solution to the transformer capacity problem as many transformers will exceed the estimated load values sooner than expected. It will be necessary, therefore, to continue a heavy load testing program. As other types of residential load appear and air conditioning saturation increases, each year's increment of room air conditioners will have a relatively smaller effect. When the predicted surge of residential central air conditioners reach major proportions, much fuller information by which to engineer distribution systems will be available.

Hydro in New England

By C. W. Mayott
The Hartford Electric Light Company

FROM a hydro point of view, as in many other ways, New England ranks among the most highly developed areas in the United States. When compared on a kilowatt development per square mile of area basis, four of its states—New Hampshire, Massachusetts, Connecticut and Vermont—rank within the highest ten states. (Table I.)

New England's industrial development has been based on the use of the many available hydro sites. With the coming of the electrical age most of the original hydro installations were electrified. The remaining undeveloped sites have been developed as rapidly as economics have justified.

TABLE I—DEVELOPED HYDROELECTRIC POWER IN THE TEN MOST HIGHLY DEVELOPED STATES IN THE UNITED STATES
Public Utility and Industrial Hydroelectric Capacity
(Not Including Non-Electrified Water Power)

Rank*	State	Area Sq. Mi.	Installed Capacity in Kw as of 1/1/53	Kw Capacity Per Sq. Mi.	
1.	Washington	68,192	3,199,593	46.92	
2.	Tennessee	42,244	1,521,300	36.01	
3.	New Hampshire	9,304	311,889	33.52	49.6**
4.	Massachusetts	8,257	242,741	29.40	
5.	Maryland	10,577	272,097	25.73	
6.	New York	49,576	1,254,896	25.31	
7.	Alabama	51,609	1,299,220	25.17	
8.	Connecticut	5,009	119,562	23.87	31.3***
9.	South Carolina	31,055	677,669	21.82	
10.	Vermont	9,609	193,442	20.13	

* Based on developed capacity per square mile.
** With the new 150,000-kw Moore Plant at Littleton, N. H.
*** With the new 37,300-kw Shepaug Plant on the Housatonic River in Conn.
Sources of data:
Area—U. S. Dept. of Commerce, Bureau of Census, as reported in 1953 Statistical Abstract of U. S.
Population—U. S. Dept. of Commerce, Current Population Reports series P. 25, No. 97.
Hydro Capacity—"Hydroelectric Power Resources of the United States, Developed and Undeveloped, 1953," F.P.C.

Capability of Hydro Plants

The capability of any new hydro development depends upon the contribution it can make to carrying the system peak load with due regard to the presence of all the other load-carrying equipment on the system, including the existing hydro plants. The installation in a hydro plant of generator capacity in excess of the availability of sufficient water to produce the necessary kilowatthours to carry the system peak load does not increase its capability. It may produce a few extra fuel-saving kilowatthours during periods of high water but will not lessen the capacity needed from other sources during low water. In other words, it does not add to the firm capability of the plant. On the basis of economics the better New England hydroelectric sites have for the most part been developed. The remaining hydro developments will show progressively higher relative costs when compared with fuel-generated power. They will, however, be developed as the load grows and when their construction can be accompliished on a basis that is economically sound.

An excellent example of this progressive development is that at the Upper Fifteen Mile Falls site on the Connecticut River. Some 20 years ago Lower Fifteen Mile Falls, now known as Comerford, was built for peaking purposes on the Boston Edison-New England Power load. At that time the Upper Fifteen Mile Falls site, now known as the Littleton site, was owned by a subsidiary of the New England Power Co., and long-range plans were outlined for its ultimate development. Now after 20 years the size of the load and other factors make the project competitive with steam and economically feasible. It is, therefore, being built as a part of the immediate power supply program.

An example of the effect of intelligent redevelopment on the capability of a system is found in the recently completed hydroelectric plant of the Holyoke Water Power Co. at Holyoke, Mass. At this location there had been previously installed 55 water wheels totaling 26,700 kw located on a canal system. After exhaustive studies and prolonged hearings, the company obtained from the Federal Power Commission a license to include an additional hydro unit of 15,000 kw at the Holyoke dam. That new unit, in operation for some time past, adds approximately 5,000 kw to the peak load-carrying capability of the Holyoke Water Power Co. system. This added capability, together with the increase in energy output, makes the unit competitive with steam. At the present time, the adding of more hydro generating capacity at the Holyoke site would not increase system capability and such additional kilowatthours as might be generated would not result in saving enough fuel to justify the additional installation.

Controversy Over New England Hydro

For many years past there has been a continuous controversy over hydro in New England. Proponents of Federal development and control have made extravagant claims as to the additional amount of hydro which they claimed could be developed at a cost far less than steam. The electric utilities which were developing hydro as rapidly as economics would warrant have attempted to show the facts, and these facts show that there is no "cheap" hydro in New England.

In 1948 the New England Council had Charles T. Main, Inc.—noted Boston engineers—make an exhaustive investigation as to the undeveloped hydro in New England. The report published in July of that year indicated 500,000 kw of economically feasible hydro undeveloped — 80,000 kw of this was at multi-purpose sites. A little more than half of the 500,000

kw has been or is being developed at the present time.

In February, 1949, in reply to a request by Senator Saltonstall of Massachusetts, the FPC stated that there was 3,119,000 kw of undeveloped hydroelectric power in New England. This included 220,000 kw for the proposed tidal-power Passamaquoddy project in Maine. The statement accompanying the claim was somewhat ambiguous and quite misleading. The claimed amount was from an office study as to amount and on the basis of short hour use as peaking capacity only. No attempt had been made to check engineering feasibility or costs. Neither were any estimates made as to when or how this hydro was to fit into New England's power supply. In August, 1949, the FPC stated that all of the claimed undeveloped hydro power was "peaking power" and could only be used in the ratio of at least three parts steam to one part hydro. Its staff also stated that it made no claim as to when or in what amount the undeveloped hydro could be used.

Rash claims have been made that 3,000,000 kw of hydroelectric capacity could replace all the steam in New England and produce power at a far lesser cost. (Approximately 5,000,000 kw of steam capacity had been installed in New England by the end of 1954.)

Feasibility Survey

A survey made by George H. Arris of the Providence *Journal-Bulletin* in 1949 showed 1,085,000 kw of undeveloped hydro that was "engineeringly feasible." This means that it is possible from an engineering and construction point of view if costs are not a factor. This report did not attempt to arrive at costs or determine when the sites should be developed.

In 1954 the FPC issued a report entitled, "Hydroelectric Power Resources of the United States, Developed and Undeveloped, 1953." This report lists 1,271,301 kw of developed hydro in New England. (Tables II and III.) The claimed undeveloped hydro in New England is 3,234,600 kw (see Table IV), but the claim is modified by FPC with this statement:

"The estimates of undeveloped water power include projects with respect to which economic feasibility has been demonstrated, as well as projects at sites where physical conditions indicate engineering feasibility and promise of economic feasibility sometime in the future. The estimates with respect to the latter class of projects are subject to revision either by increase or decrease as additional information becomes available concerning stream flow, reservoir sites, costs and other pertinent factors."

Note that the FPC estimates of undeveloped hydro potentialities are, in general, those that *indicate* engineering feasibility.

The New England-New York Inter-Agency Committee has made an exhaustive study of all the possible hydro sites in New England. Their reports, while not yet in final form, are available for inspection. Final public hearings are being held to review the reports before presenting them to the Governors of the States and then to the President.

TABLE II—DEVELOPED HYDRO IN NEW ENGLAND—AS OF JANUARY 1, 1953
By Rivers

River	State	Kw Capacity	Average Annual Generation (Kwhr)
St. John	Maine	2,300	5,300,000
St. Croix	Maine	11,152	55,500,000
Pennamaquan	Maine	96	600,000
Machias	Maine	1,670	5,300,000
Union	Maine	8,900	24,000,000
Penobscot	Maine	87,601	495,959,000
Megunticook	Maine	1,065	2,480,000
Kennebec	Maine	131,981	619,140,000
Androscoggin	Maine & N.H.	139,039	767,730,000
Presumpscot	Maine	10,660	60,802,000
Saco	Maine	43,585	215,300,000
Mousam	Maine	2,056	2,290,000
Salmon Falls	Maine	10,164	28,280,000
Merrimack	N.H. & Mass.	99,939	336,440,000
Coaticook	Vt.	125	200,000
Clyde	Vt.	5,800	17,400,000
Missisquoi	Vt.	5,055	18,500,000
Lamoille	Vt.	21,340	77,271,000
Winooski	Vt.	17,600	72,300,000
Otter Creek	Vt.	24,405	83,670,000
Hudson	Vt.	325	270,000
Poultney	Vt.	270	600,000
Charles	Mass.	747	1,070,000
Neponset	Mass.	775	1,040,000
Providence	Mass. & R.I.	11,012	24,330,000
Thames	Mass. & Conn.	21,012	59,120,000
Connecticut	N.H., Vt., Mass. & Conn.	522,521	1,893,920,000
Housatonic	Mass. & Conn.	90,106	211,470,000
Total New England		1,271,301	5,080,282,000

TABLE III—TOTAL DEVELOPED HYDRO IN NEW ENGLAND—AS OF JANUARY 1, 1953
By States

State	Kw Capacity	Average Annual Generation (Kwhr)
Maine	393,715	1,968,201,000
New Hampshire	311,889	1,105,470,000
Vermont	193,442	794,591,000
Massachusetts	242,741	876,010,000
Rhode Island	9,952	22,350,000
Connecticut	119,562	313,660,000
Total	1,271,301	5,080,282,000

In addition to the above the following hydroelectric power plants have been put in operation since January 1, 1953, or are at present under construction.

Put in service in 1954

Indian Pond—Kennebec River, Me. ..... 45,000 kw

Under construction in 1954

Upper 15 Mile Falls, Connecticut River, N. H. ...150,000 kw

Shepaug, Housatonic River, Conn. ..... 37,500 kw

Indian Pond, Kennebec River, Me. ..... 30,000 kw

Reports Compared

A river-by-river comparison of the FPC report with the data available in the New England-New York Inter-Agency Committee report is shown in Table IV.

The data in Table IV show that there are only two projects—the St. John and the redevelopment at Enfield—that can produce hydro power at costs equal to or lower than the costs of producing the same power at steam stations.

In the NENYIAC report, except for the Connecticut River and the St. John River, the developments on the various rivers are lumped for the river and called an "inventory plan." The benefit-costs given are therefore an average in which the poorer developments are lumped with the better. This conceals the poorer projects

but also fails to show the true value of the better ones.

The Inter-Agency Committee Connecticut River projects are listed in Table V.

Relative to the Connecticut River, the NENYIAC report states that

"The storage and power potentialities of some 350 sites . . . have been considered. Preliminary investigations revealed that many of those sites were not feasible of development of power or power storage, and no further consideration was given to the development of these sites for such purposes. Detailed investigation and study of 65 sites revealed that only eight might be considered as economically feasible of development at such time as the additional capacity would, subject to cost levels existing at the time, integrate with the load pattern and system requirements of the area. Three of the projects—Hart Island, Meadow and Enfield—are for power only; three—Indian Stream, Browns Mill and Williamsville—are for power with power storage; one—Victory—is for multiple-purpose storage; and one —Gaysville — is a multiple-purpose project for power generation and power and flood control storage."

The details for undeveloped hydro on the St. John River are as follows:

Sub-basin	Capacity (Kw)	Annual Available Energy (Kwhr)	Benefit-Cost Ratio*
St. John River	230,000	900,000,000	1.09
Fish River	7,500	31,700,000	.45
Aroostab River	18,000	70,700,000	.60

* See footnote under Table IV.

Table VI gives some of the detailed data for Subregion A—Maine.

For Maine and part of New Hampshire the NENYIAC report states that generating capacity now scheduled to go into operation before 1960, combined with existing capacity that will remain in service, will be sufficient to meet Subregion A anticipated utility power requirements in that year. Both capacity and energy needs will be provided and an adequate margin will be available for reserves.

Between 1960 and 1975 there will occur a considerable growth in total utility requirements for Subregion A, estimated as 275,000 kw. The NENYIAC report also states that analysis of the inventory power plans of Subregion A (Maine and part of

TABLE IV—UNDEVELOPED HYDRO IN NEW ENGLAND—FPC AND NENYIAC ESTIMATES

River	FPC	New England-New York Inter-Agency Committee with Benefit-Cost over .6			
	FPC Estimate 1953 (Kw)	NENYIAC Estimate Development (Kw)	Benefit-Cost Ratio*	Redevelopment (Kw)	Benefit-Cost Ratio*
St. John	258,000	255,500[a]	1.03	.....	....
St. Croix	10,000	.....	....	.....	....
Penobscot	435,500	309,500	.54	10,925	....
Kennebec	534,000	461,000	.93	11,570	....
Androscoggin	370,000	92,500	.76	21,000	....
Saco	123,000	52,400	.66	17,575	....
Maine Coastal	.....	4,000	.58	.....	....
Merrimack	322,000	137,000	.56	.....	....
Connecticut	934,000	280,500[b]	[c]	57,900[b]	1.09
Thames	.....	.....	....	.....	....
Housatonic	81,300[d]	.....	....	.....	....
Missisquoi	40,600	.....	....	.....	....
Lamoille	17,900	.....	....	.....	....
Winooski	69,200	4,800	.77	.....	....
Otter Creek	39,100	.....	....	.....	....
Total	3,234,600	1,596,700			

* A benefit-cost ratio of one indicates that the cost of producing hydro power by the project is the same as if it were generated in a steam plant, with comparable taxes. A benefit-cost ratio of .5 indicates that the hydro costs twice as much as comparable steam.

a. Inventory plan with three projects.

b. The 57,900-kw redevelopment at Enfield is included in the 280,500-kw new development.

c. See Table V for details of Connecticut River.

d. Includes 2000 kw in New York State, also the Shepaug development.

TABLE V—SUMMARY OF NENYIAC POWER INVENTORY PROJECTS FOR THE CONNECTICUT RIVER BASIN N.H., Vt., Mass. and Conn.

Project	River	Drainage Area Sq. Miles	Proposed Installed Capacity (Kw)	Annual Charges	Annual Benefits	Benefit-Cost Ratio*
Indian Stream	Conn.	256	20,000	$ 1,081,000	$ 839,100	0.78
Browns Mill	Paul	51	9,000	516,000	356,400	0.69
Victory	Moose	75	.....	114,000	72,200	0.63
Gaysville	White	226	10,700	728,000	449,300	0.62
Hart Island	Conn.	4,663	25,200	1,663,000	1,131,400	0.68
Williamsville	West	407	145,000	5,263,000	4,320,000	0.82
Meadow	Deerfield	560	12,700	628,000	526,500	0.84
Enfield	Conn.	9,719	57,900	2,313,000	2,508,900	1.09
Total			280,500	$12,306,000	$10,200,300	

* See footnote under Table IV.

TABLE VI—SUBREGION A

River Basin	Installed Capacity[1] (Kw)	Average Annual Energy[1,2] (1000 kwhr)	Total First Cost ($1000)	Annual Cost	Annual Benefits	Benefit-Cost Ratio*
St. John	255,500	1,002,400	$ 87,330	$ 9,206,900	$ 9,479,900	1.03
Penobscot	309,500[3]	1,611,850[3]	221,175[6]	24,566,000[6]	13,383,700	.54
Kennebec[4]	461,000[5]	1,387,740[5]	171,198	19,042,800	17,769,800	.93
Androscoggin	92,500	461,360	52,976	5,948,600	4,527,000	.76
Saco	52,400	138,700	29,811	3,226,000	2,137,620	.66
Maine Coastal	4,000	10,200	2,449	276,000	161,000	.58
Total	1,174,900	4,612,250	$564,939	$62,266,300	$47,459,020	.76

* See footnote under Table IV.

1. Total of new projects after deducting for existing plants replaced.

2. Includes additional energy at existing downstream plants resulting from storage provided by inventory plans.

3. Includes Ripogenous Project currently under construction—36,000 kw—250,000,000 kwhr.

4. Includes Indian Pond Project currently under construction—75,000 kw installed.

5. Not adjusted for loss of existing installation at Madison.

6. Does not include Ripogenous.

New Hampshire) to determine to what extent the characteristics of developments, namely capacity at various sites and associated energy under adverse stream-flow conditions, could be utilized in meeting the requirements of Subregion A. Utility requirements indicate that of the additional 275,000 kw needed between 1960 and 1975 about 152,000 kw could be furnished by projects in the inventory power plan. In addition about 60,000 kw could be utilized in Subregion B, consisting of most of New England other than Maine, by 1975. It thus appears that the characteristics of the 1,225,000 kw included in inventory power plan for Subregion A would be such as to permit utilization within the United States of about 212,000 kw, or approximately 17%, by 1975.

For the Vermont rivers draining into Lake Champlain the New England-New York Inter-Agency Committee report observes:

Missisquoi River

None of the projects studied in this basin meet the benefit-cost ratio requirements—3 were studied in detail. They had a benefit-cost ratio of 0.3.

Lamoille River

None of the projects studied in this basin meet the benefit-cost ratio requirements—6 were studied in detail. They had a benefit-cost ratio of 0.3.

Winooski River

Only one project studied on this river, that at Burlington with a benefit-cost ratio of .77, met the criteria for inclusion in the inventory plan. Two others were studied in detail. The benefit-cost ratio of all the three was 0.46.

Otter Creek

None of the projects studied on this river meet the benefit-cost ratio requirements. One was studied in detail. Its benefit-cost ratio was 0.39.

Hydro on the Housatonic

The FPC report lists 81,300 kw of undeveloped hydro on the Housatonic River (See Table I). Almost half of this is at Shepaug, which is under construction and well on its way to completion.

The New England-New York Inter-Agency Committee report states as follows:

"7. With a view to determining the power and storage potentialities of the Housatonic River Basin, studies were made of the development possibilities of some 100 dam sites. . . . Preliminary investigations revealed that many of these sites were not feasible of development and they were eliminated early in the course of the study. Thirteen sites were investigated in detail and none were found to have sufficient benefits to justify their inclusion in a basin inventory at the present time. In evaluating each considered development, costs were taken as those that would be incurred by a private utility or industry. The power values used in determining benefits were predicated on the cost of the cheapest alternative source of power, in this case, privately financed steam generation. Although none of the sites were found to be economically feasible of development at this time, it is reasonable to anticipate that one or more, owing to changed economic conditions in the future, may prove eventually to warrant further consideration."

In other words, there are no remaining sites on the Housatonic River that can produce power at a cost as low as the cost of generation by steam power.

The FPC lists no undeveloped sites on the Thames River. There are some that have been abandoned.

NENYIAC on Thames River

The New England-New York Inter-Agency Committee report on the Thames River states as follows:

Hydroelectric Power Inventory

"4. Studies were made of the development possibilities of all known undeveloped power and storage sites with a view to determining the power potentialities of the basin. Many of these sites were eliminated from further consideration because of their small drainage areas and small storage and power possibilities. Other sites having larger drainage areas did not prove attractive due to the low flow in the river during periods of critical power demand. No storage for the purpose of increasing low flows could be obtained at justifiable costs. The studies indicate that there are no sites meeting the minimum conditions of economic justification required for inclusion in an inventory of undeveloped power."

The report of the Committee of New England of the National Planning Association, Number 5, "Water, Fuel, and Energy in New England," makes a number of pertinent statements relative to hydro in New England and its possible effects on New England's cost of power. Some of these statements are as follows:

"*Individual Electric Systems:* Most large electric utilities in New England have several generating plants. In many instances part of the capacity is hydroelectric and part is thermal electric. The problems of deciding which type of plant to construct when expanding and how to use the various plants in conjunction with each other are complex."

"There are a number of reasons for the shift from hydro to steam. One major reason is that economic sites for locating plants were first put to use before the advent of electricity. The best sites naturally were developed first and converted to electric power generation first. In New England, as a result, hydroelectric development has been more intensive than in any comparable region. While from an engineering point of view there is still considerable undeveloped power potential in New England's rivers, there are important limitations on the economic feasibility of many of the sites.

"In spite of a widespread public belief to the contrary, water power is not always cheaper than steam power. While the operating costs of hydroelectric generation are much lower than those for steam generation, the capital costs of a hydroelectric project are usually much higher than for a steam plant of equivalent capacity. Furthermore, hydroelectric plants frequently must be located at great distances from load centers, involving costly transmission systems and transmission losses. Cost comparisons between hydro- and steam-generated power must take into consideration both the operating expenses and the capital and other fixed charges, as well as probable trends in future expenses and demand.

"An alert public that keeps its interests before the public utilities is highly desirable, but indiscriminate public pressure for hydroelectric development without a full understanding of the complexities of generation, transmission, distribution, serves no useful purpose."

"Interconnection is a major factor

in holding down power rates for two primary reasons: it reduces the necessary investment in production facilities and it reduces actual production expenses."

"In general, New England's public utilities have integrated their capacity-expansion programs, transmission systems and day-to-day operations to raise the level of their efficiency to high standards."

Relocation of Plants

"So far as the relocation of existing manufacturing plants is concerned, it appears that power costs alone are rarely an important factor.

"The opinions on power costs substantiate what has been stated earlier in this section about the effects of power cost on industrial development and industrial location. Power rates and costs are not a universal problem in New England, but they do affect individual industries, companies and localities. Taken alone, they represent a small competitive obstacle for the New England economy as a whole.

"Since steam plants will almost certainly provide a rising proportion of the region's electric power, regardless of how the region's undeveloped hydroelectric power is utilized, it appears that full equalization of power-production cost and power rates between New England and the country as a whole will be impossible unless a cheaper fuel becomes available.

"Without attempting to pass judgment on the engineering appraisals, it seems fair to say that under private financing and ownership the amount of new hydroelectric capacity in the region that can be economically added to the private utility systems of New England by 1970 is no more than 15% of the total expansion that will be needed during that period, and it is probably less than 10%. The declining proportion of hydroelectric to total capacity will undoubtedly continue in New England, as in the country as a whole."

A Long-Term Possibility

"There is no doubt that the economical development of Passamaquoddy power is at best a long-term possibility, dependent on construction costs, alternative sources of power, transmission expenses and load growth. Until adequate engineering data are available, feasibility cannot even be determined."

"Hydro can contribute, to be sure, and it should be pushed along as fast as is economical. Water-power developments can be of special importance in particular communities. But anyone who advocates hydroelectric power as a panacea for New England's higher-than-average power rates is guilty of a cruel deception."

Trend Likely To Continue

"The trend toward construction of steam plants at tidewater, where water deliveries of oil and coal can minimize transportation costs for fuels, will probably continue until the economical use of nuclear fuels frees the plants from fuel-transportation considerations. The expandable plant, designed for the construction of additional generating units as demand rises, may well become increasingly important."

Fuel Price Obstacle

"No matter what the region's utilities do to reduce expenses, however, their higher fuel prices stand as a major obstacle to cost and rate equality between New England and the country as a whole."

"Within the last few years a possibility much more promising than any other alternative for equalization of New England's power rates with those in the rest of the country has changed from a visionary idea to a near-term opportunity. The substitution of nuclear fuels for combustion fuels seems to be far closer to reality than was generally expected just a short time ago."

President Quinton on Dixon-Yates Contract

HAROLD QUINTON, President, Edison Electric Institute, and President, Southern California Edison Co., on February 2 sent the following telegram to both Edgar Dixon, President of Middle South Utilities, Inc., and E. A. Yates, Chairman of the Board, The Southern Co.

"W U, Los Angeles, Calif., Feb. 2.

"I note in the press a suggestion that the electric utility industry prevail upon you to cancel the power contract between the Mississippi Valley Generating Co. and the Atomic Energy Commission.

"I want to state that the investor-owned electric power industry wholeheartedly supports the basic philosophy of the government in calling on private enterprise to perform those jobs which it is willing and able to do. Judging by newspaper articles and editorials, the press also generally favors this philosophy. I am certain it is the general opinion of the electric industry that the Mississippi Valley Generating Co. contract with AEC is a splendid example of cooperation between private citizens and the government. The government will be able to buy power at favorable rates for a long term of years, and taxpayers will avoid a construction expenditure of some $100 million.

"This contract represents the third occasion on which the AEC has made a long-term contract for purchase of a large block of power from a company sponsored by business-managed utilities and financed entirely with private capital. The rates to the government under this contract have been found by qualified experts to compare favorably with those under other AEC power contracts.

"You and the electric utility organizations you represent are doing a splendid service in the public interest in standing firm on the Mississippi Valley Generating Co. contract."

Study By	*Undeveloped Potential*	*Basis of Estimate*
New England Council, Power Survey Committee	500,000 kw	Economic feasibility on the basis of private financing if and when it can be worked into the load; including 80,000 kw of dual flood-control and power projects and excluding Passamaquoddy.

A Portable Transcriber for Meter Reading

By Kenneth E. Iverson
Instructor in Applied Mathematics, Harvard University

IN spite of the fact that over seventy-five million electric and gas meters are read periodically in America, no special devices have been developed for use by meter readers in recording the data obtained. Instead, readings are normally recorded with a pencil in writing or, in the case of a few utilities using punched card accounting, on mark sense cards.

There are a number of reasons for this situation. First, the simple method of pencil and paper offers speed, accuracy and low cost which can hardly be surpassed where the resulting figures are to be handled manually in the subsequent accounting operations. Second, the low unit cost per reading already attained by most utilities leaves little margin for savings through any increased production made possible by a special recording device.

On the other hand, the introduction of electronics in accounting procedures makes it desirable to record the original meter reading in some form which may be read mechanically. This not only eliminates the cost of an additional key-punching operation in the office but removes this key punching as a source of error and reduces the delay between the reading of a meter and the dispatch of the bill.

Accounting Considerations

Direct meter communication with the accounting office by radio or other techniques may be regarded as the ideal solution of the meter-reading problem. However, the small unit cost of reading meters is completely inadequate to finance any presently available techniques. The same consideration precludes the possibility of equipping each meter with a card-perforating or other device for automatically recording the reading on a card inserted by the meter reader. The remaining alternative is to provide the meter reader with a portable "transcriber." The latter term is introduced to denote any device which may be operated manually to produce a mechanically readable record.

It appears that no satisfactory portable transcriber for meter reading exists at present, and, in view of the accelerating trend toward the use of electronic equipment, the design of a suitable device warrants considerable attention. In this paper an attempt has been made to lay down criteria for a suitable portable transcriber, and to explore several promising avenues for development. One of these avenues has led to the construction of an experimental model which is fully described.

In order to be acceptable for use in meter reading, a portable transcriber must satisfy a number of requirements. It must be:

1. Capable of producing a record suited for reliable reading by mechanical means;
2. Cheap to produce in limited quantities;
3. Light and easy to carry;
4. Quick and easy to use;
5. Amenable to proofreading and subsequent correction by the meter reader;
6. Arranged to allow limited sorting or searching;
7. Usable in bad weather;
8. Arranged to provide all data, such as street address, meter number, etc., as required by the meter reader.

The device must produce a mechanically readable record since the main advantage to be gained is in the elimination of subsequent key punching. Because of the limited demand, which is roughly 3000 for the entire country, it must be cheap to produce in limited quantities. However, its potential use in other applications may change this situation somewhat.

To gain acceptance by meter readers the transcriber must be light and easy to carry. Since it is uneconomical to limit the length of a route because of the weight of the records required, the maximum weight should be considered as well as the average.

The transcriber should be simple to use so as to reduce the training required and to minimize the probability of error. The importance of quick operation becomes apparent when it is noted that the addition of only eight seconds per reading adds a full hour to an average day's work of reading 450 meters.

The desirability of proofreading and correction by the meter reader is apparent. Indeed, the policy of many companies is to provide the reader with sufficient information on past consumption to allow him to check the reading for "reasonableness" and to double-check with the meter if necessary.

Order of Accounts

In general, the order of the accounts for billing purposes is determined by the order in which the meters are read. However, it may be convenient, for purposes of reference, to group together all accounts in a given route which are located on a given street, and to arrange the streets alphabetically within the route. Furthermore, it may be undesirable for a number of reasons to impose a rigid reading order. Clearly then, provision must be made for a limited sorting of the accounts by the meter reader. In the case of a meter book, made up of a separate sheet for each account, this is easily accomplished by leafing through the book to locate the desired account. With somewhat more difficulty cards can also be sorted, and this problem requires serious attention only when a tape or other continuous medium is used for the record.

The meter reader must be provided with a certain amount of information, including at least the street address and meter number for each location. Whether this information is furnished by a separate route book or is incorporated in the transcriber itself, it must be explic-

itly taken into account when evaluating any proposed system.

From the foregoing it is apparent that a portable transcriber must satisfy rather stringent requirements.

The following discussion is based on the reading of five-dial meters. A strong case might be made for standardizing on four-dial meters since the relative error in computed bills, due to the smaller number of dials, could be kept below one part in a thousand. Furthermore, this error would not be cumulative. Nevertheless, the present use of five-dial meters is general enough to dictate the use of a transcriber capable of handling five columns of digits.

Any method of recording may be applied to either tapes or cards. The distinction between tapes and cards made here is not based on size or shape but rather on whether each reading is recorded on a physically separate card or all readings in a route are recorded on a single tape.

Providing Reader's Information

Before the relative advantages of tapes and cards are considered, the means of providing the reader's information will be discussed briefly. It is clearly more convenient for the reader to have such information appear on the same card or tape used for recording the meter reading, since this avoids the necessity of carrying and consulting two separate records. It will therefore be assumed henceforth that the medium to be used for recording is the same used to provide the reader's information. It may be required to print or punch this information on a new tape or deck of cards each month. However, it should be noted that this may be done mechanically at relatively low cost.

The main advantage of cards lies in the ease of sorting. But if a tape device can be designed which allows fast enough scanning to provide the limited sorting required, then tapes offer a number of advantages.

If the advantage of easy sorting is to be realized, cards must be handled manually. They are slower to handle and more difficult to protect from the weather than a tape, which may be carried on rollers and almost completely protected. Furthermore, convenience of handling sets a lower limit to the size and thickness of a card which is considerably above the actual size required for the recording of the information. Thus, the volume and quality of paper required for cards are considerably greater than for tape.

Advantages of Tape

In consulting the information provided on a tape the reader sees also the information on adjacent locations, whereas with cards he would have to pick up several to obtain the same information. Finally, since cards may be expected to get out of order, each card must carry in mechanically readable form the serial number identifying the particular service location. This is not required for tapes since the relative locations of the readings are fixed and serve to identify each reading. This is an important consideration, since the cards must be both printed, to provide the reader's information, and punched, for identification. This requires two separate operations in the preparation of cards as opposed to one for tapes. On the other hand, the omission of a mechanically readable identification for individual items on a tape introduces the possibility of gross errors due to the tape getting out of phase. Auxiliary checks are easily devised, however, to prevent errors of this kind.

If the length of tape required per reading can be reduced to 1/3 in., then the total length required per route will be only about 12 ft. Therefore, the problem of providing sufficiently rapid scanning will not be serious, and, because of the many advantages they offer, the following discussion will be limited to tapes. Nevertheless, some of the techniques to be considered have application to cards as well.

Tape Should Be Short

In the interest of quick scanning the tape should be as short as possible. Hence, each reading will be assumed to occupy a single line and the width of the tape required will be determined accordingly. Methods of transporting and positioning the tape will be taken up following a discussion of possible methods of recording.

Among the possible methods of recording, mark sensing clearly requires the least equipment as regards both cost and weight. A major defect of mark sensing as presently used on cards is the care required of the operator in making a firm, carefully positioned mark, and the relatively frequent ocurrence of errors due to improper registration in spite of this care. However, the defect may be removed by providing the transcriber with a mask or stencil for accurately positioning the pencil marks on the tape. In view of these remarks mark sensing is chosen as the most suitable method of recording.

The simplest procedure would be to provide a mask of 50 vertical slots across the width of the tape, one to represent each decimal digit in each of five columns. However, this would result in a very wide tape, for on the basis of ¼-in. spacing, more than 12 in. would be required.

Tape Width May Be Reduced

The required tape width may, however, be considerably reduced by coding each decimal digit as a combination of four binary digits, as follows. Each of the five columns is to be represented by a single transverse line on the tape, the particular decimal digit being indicated by the positions of the two ends of the line.

The limitation to a single continuous line is imposed for speed and ease of recording. As a further practical restriction, the reading device must be so arranged that the current flow from any brush passes only to an adjacent brush. This restriction is adopted to avoid, in the interest of reliability, the necessity for current flow through long sections of the graphite mark. These considerations lead to the coding scheme shown in Fig. 1. The two positive brushes shown furnish power to the remaining four brushes through connections furnished by the pencil marks. The number N of codes available in such a system (excluding the case of no mark) depends as follows on the number n of negative brushes used:

$$N = \sum_{k=1}^{n} k = \frac{n(n+1)}{2}$$

Thus four negative brushes provide exactly ten codes which may be as-

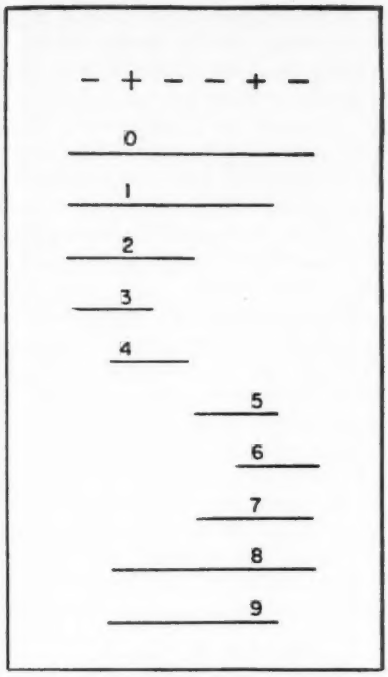


Figure 1—Coding Scheme

signed to the decimal digits in any desired way. The particular scheme of Fig. 1 was chosen for appearance only.

For reasons of speed and accuracy the coding operation cannot be left to the operator. However, it may be accomplished by providing five stencils, each with slots corresponding to the coding scheme of Fig. 1. The tape passes under a flat cover which is provided with a single slot across the width of the tape. The stencils are carried on this cover and are allowed to slide in a direction perpendicular to the slot in the cover. Thus, by inserting a pencil in any desired digit, moving either up or down until the pencil drops into the slot in the cover, and then moving it to the left or right as far as possible, the appropriate mark on the tape is obtained. The entire process is very fast and allows proofreading. Proofreading may be obtained before marking by adding a line of holes, one beside each slot in the slide. The main slot in the cover beneath these holes is cut only part way through so that the slide may be positioned by means of these holes without marking the tape. It may be remarked in passing that the use of sliding stencils might be applied

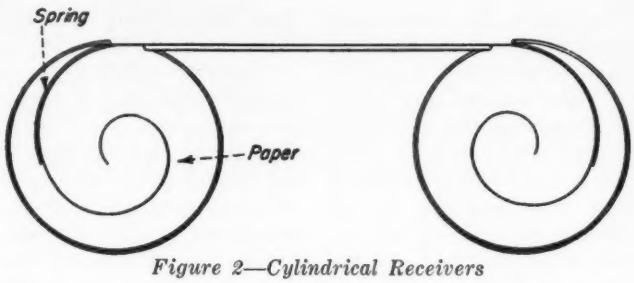
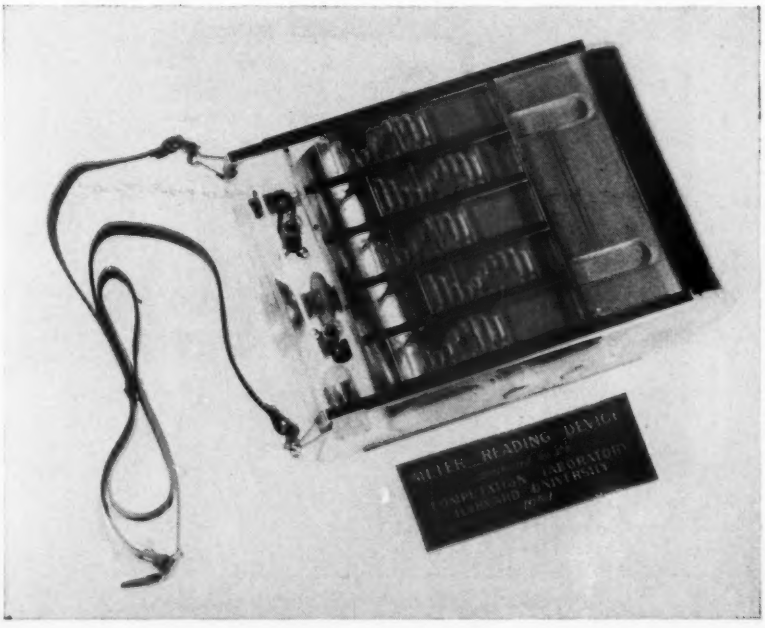


Figure 2—Cylindrical Receivers

equally well to the operation of punches.

The means of transporting and positioning the tape remains to be considered. A straightforward solution could be provided by a sprocket roller with detent and two spring-loaded take-up rollers. However, the moving parts required would probably constitute the major cost of the whole device, and it is proposed that they be dispensed with as follows. The take-up rollers may be replaced by cylindrical receivers, as shown in Fig. 2. The strip of light spring brass shown in each cylinder forces the paper into a roll of somewhat reduced radius and prevents binding. Experiments show that with suitable paper, lengths up to 15 ft may be handled satisfactorily by this means. Allowing 1/3 in. per entry, nearly 500 readings may be recorded on such a tape. This is adequate for the average route and, if necessary, spare rolls may be carried.

The sprocket roller may be dispensed with by providing a slot in the cover through which the operator may move the tape with his thumb. The operator must then move the tape so that the printed information is correctly positioned relative to certain marks provided in the window. Clearly, such positioning will not be so accurate as that provided by a sprocket roller. However, if the marks themselves are used to provide the "clock" impulse for reading, accurate positioning is not required. Errors which would arise from missing readings could be prevented either by a visual scan of each tape in the office or by setting an upper limit to the amount of tape allowed to feed between successive readings. This limit would be set at somewhat less than twice the normal length between readings and would act to halt the reading process. Note that readings not obtained because of "locks" would not be con-

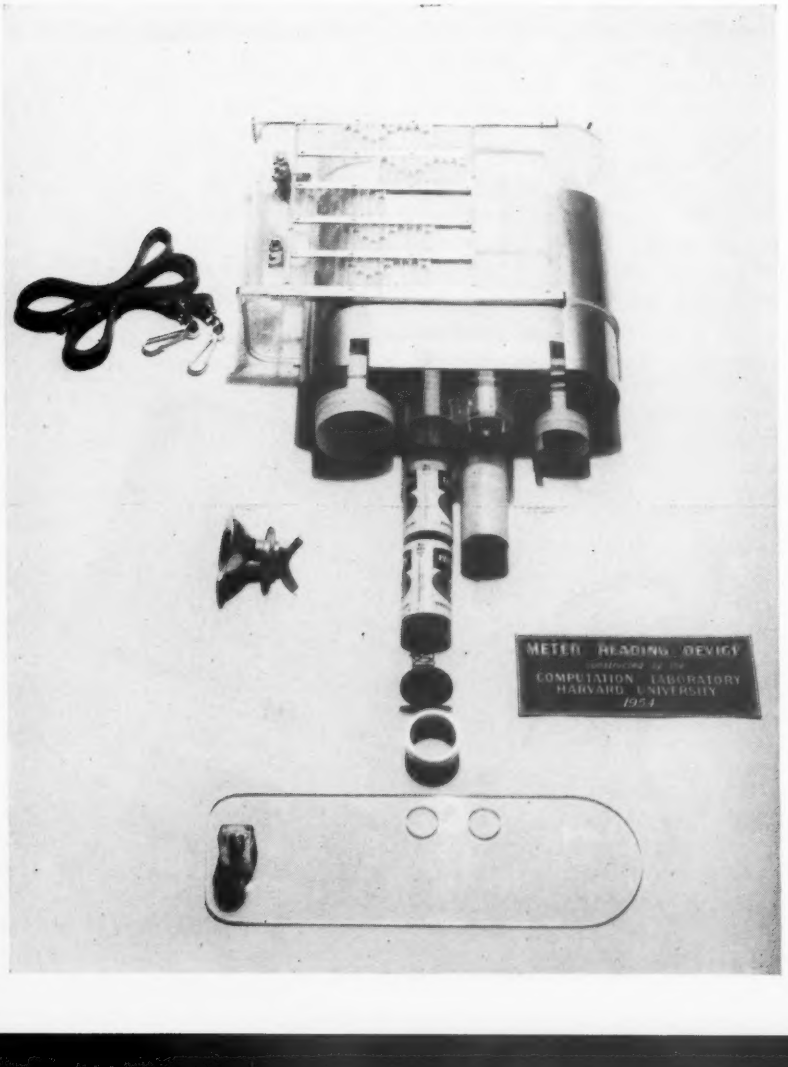


sidered missing in the sense used here but would instead be indicated by some special mark, e.g., a zero in the lowest order column only.

A transcriber using this method of tape transport combined with mark sensing by stencils would be cheap to construct, light and easy to use and would generally satisfy the requirements previously listed. An experimental model has been constructed and is exhibited in the accompanying photographs. A brief description follows.

Transcriber Materials

The outer case is formed from a single sheet of ⅛-in. lucite. One side is permanently closed by a sheet of lucite while the other side is closed by a snap cover of the same material. The paper receivers consist of 3-in. brass tubes and are silver soldered to the flat sheet of brass which backs the active section of the tape. The four lucite tubes are provided to carry flashlight batteries, spare rolls of tape and pencils. The top of the lucite case is cut by a horizontal slot for mark sensing and larger thumb slots for moving the tape, as seen in the accompanying photographs. The stencil slides are also shown and are carried in aluminum guides with a light friction spring. The flat section below these guides serves as a window for scanning and positioning the tape. Illumination of the window and slides is provided by edge-lighting the lucite case with two flashlight lamps. An ordinary flashlight head slipped into the forward end of the case replaces the flashlight normally carried and leaves the operator's hands free. All three lights operate from a single toggle switch. Two tubes containing two dry cells each may be operated in parallel, or alternatively, one tube may be reserved for spare batteries.



A few comments on the use of the transcriber are in order. First, it should be noted that the tape itself is almost completely covered and the thumb slots are so placed as to avoid any contact with the area of the tape carrying pencil marks. Furthermore, the device will normally be carried by straps so placed that the top face is protected by being carried against the reader's body.

The preparation of the tape itself is extremely simple since it requires printing only. Although sprocket holes are not required they may be added in any of the four areas which are not used for marking. The 6⅜-in. width of the tape allows the printing of as many as 60 characters, sufficient to provide all information necessary to the reader. Rapid scanning is aided by the large window area provided.

Operating the Transcriber

In operation, the information concerning the meter to be read is first brought into position. When the meter has been located, the meter number is first checked and the reading is then recorded and proofread. Alternatively, the slides may first be set and proofread before the actual mark is made. A slot for erasure could be provided but was omitted because of the possible effects of eraser crumbs moving on the face of the tape. An error may still be corrected by marking zeros in all columns and by writing the correct reading in the thumb slot in the corresponding printed line. The reading device is then programmed to stop at any reading made up of all zeros and the machine operator introduces the correct numbers indicated in writing. Such operation will cause an unnecessary stop on any correct reading which happens to be zero, but the expected frequency of such an occurrence would be only two or three times per year.

The policy of some utilities is to have the meter reader compute the consumption and check it against previous consumption. If the consumption appears unreasonable, the meter reader double-checks the meter reading. If a manual accounting system is used, the subtraction must be done by someone so that the reader's work fulfills a useful func-

(*Continued on page* 61)

Progress Report on
Chemical Heat Storage

PREPARED BY THE JOINT AEIC-EEI HEAT PUMP COMMITTEE

The possible use of chemical heat storage in conjunction with a heat pump system has been of interest to the Joint Committee for several years. A preliminary investigation on the possible use of disodium phosphate dodekahydrate was made for the committee at Massachusetts Institute of Technology. Indications based on the results of this study were published in a report by the Joint Committee in the September, 1950, BULLETIN. As a result of the initial work a laboratory test program was carried out at the General Laboratories of American Gas & Electric System in Power, W. Va. These tests were described in an article published in the May, 1952, BULLETIN. Heat storage systems were assembled in actual operation with heat pump units and a series of field tests carried out. Results of these field installations showed that reliable cycling of the chemical was not possible with the arrangement used. Additional laboratory work with a special heat storage chamber was initiated and this article is a report on this phase of the investigation.

SENSIBLE heat storage systems, using water, gravel, rock, steel or similar material, whose temperature can be increased without change of phase, have been used with limited success mainly because of the rather large space requirements. More practical storage systems would be possible if a substance having larger heat capacity per unit volume were available. If, for example, chemical heat storage could be made suitable, the storage space could possibly be reduced to from ¼ to 1/5 of that required by water.

The use of heat storage is particularly attractive in conjunction with an air-to-air heat pump unit because it suggests a possible solution to the design problem of having the lowest temperature heat source at the time when heating requirements are greatest.

Other Uses Listed

The future of heat storage is not limited to use with air-to-air heat pumps; it may also be used to advantage with other heat sources, or it can be used for timing the load to better fit the peak responsibility curve of the electric utility's distribution system. Storage also permits the reduction of the maximum demand which increases the load factor by permitting smaller capacity air conditioning equipment to operate for longer periods. Another promising application for storage is in conjunction with a solar heating system for direct utilization or as an auxiliary heat source for a heat pump. This later use has been tried and operating results were discussed in a previous report.

To examine the possibilities of heat storage, a laboratory test was carried out during the fall of 1951 to determine (1) the reversibility of small cylindrical containers of disodium phosphate dodekahydrate, (2) the amount of heat released and absorbed by the chemical during each cycle, and (3) the necessary length of melting and freezing cycles when exposed to a temperature of 115 F and 80 F, respectively. A report on this investigation was published in the May, 1952, BULLETIN.

As a result of these laboratory studies field test installations were made, each using 6000 of the small containers with the chemical and recrystallization medium used in the laboratory tests. It was calculated that this amount of chemical would have a storage capacity of about 300,000 Btu between the temperatures of 80 F and 115 F. In these initial field

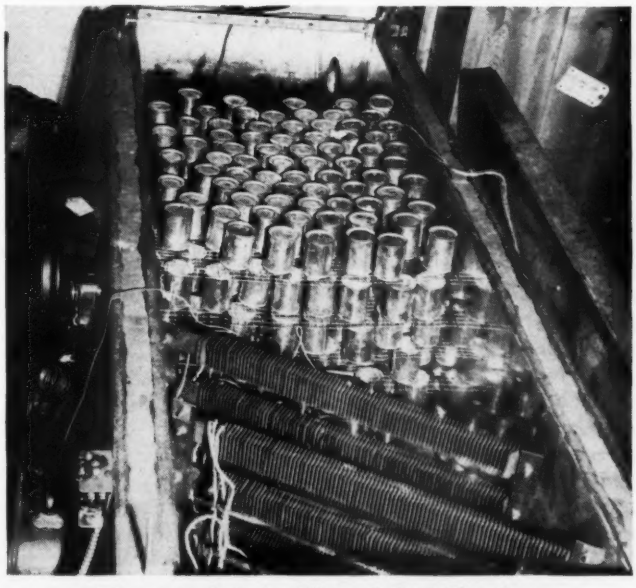


Figure 1—Interior View of Test Chamber.

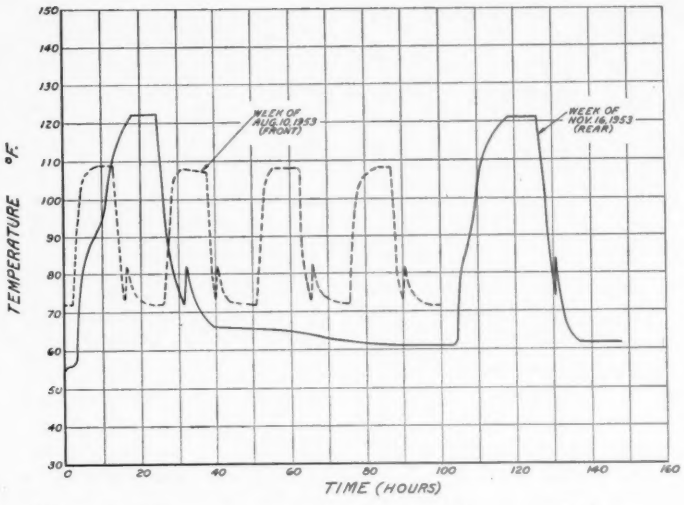


Figure 2—Temperatures at Center of Thermocoupled Can.

test installations water was used as the transfer medium between the storage unit and the heat pump system.

These first field installations indicated the chemical, as used, was not completely reversible between the liquid and solid stage at positive, dependable temperatures when using water as the transfer medium. Considerable subcooling was frequently needed before crystallization would take place, indicating that the seed crystal was not fully effective. Analysis showed that only about 22 to 40 per cent of the salt was really effective during the average melting cycle instead of the expected 80 to 85 per cent.

Air as Transfer Medium

Other investigations using the same type containers and employing air as the transfer medium indicated a less effective reversibility than when water was used. As the transfer of heat from the surface of the containers might be the limiting factor in the effective capacity, the less favorable results with air were to be expected since air has a much lower heat transfer coefficient than water. It was decided to use air as the transfer medium on all future tests because reasonable results with air would indicate equal or better operation with other media.

The preliminary tests indicated that there was need for a better "seed crystal" to insure proper cycling of the chemical between the heating and cooling phases. After several months of laboratory investigations a cooperating chemical manufacturer produced a new crystallization medium which seemed to have much better control of the change of state phenomena of the phosphate salt being used. A number of containers were made up including this new seed crystal and a full-scale test was initiated in the fall of 1953. The remainder of this report will be concerned with this test and the results obtained.

The test equipment included 468 containers of the chemical arranged in an insulated inclosure 22 x 18 in. x 6 ft. Cooling coils and 15 kw of resistance heaters were installed within the test chamber and the containers were arranged in layers so that air could be passed through the entire mass. Figure 1 shows the test chamber with the top removed. The resistance heaters are in the front of the chamber, and the cooling coils, which are not visible, are directly behind the resistance elements. The incoming and outgoing air temperatures were recorded and one container had a thermocouple located in the center so that the salt temperature could be constantly recorded.

The container with the thermocouple was located in the middle of the front row (see Fig. 1) during the first part of the test and in the back row during the second half, in order to see if location within the chamber had any effect on the melting and freezing of the salt. Figure 2 shows the salt temperature variation at the center of the container for the melting and freezing cycle during two typical weeks, one with the container at the front and the other with the container at the back of the chamber. The heat of fusion of the salt is 96 F but it can be noticed that in all cases the salt had to be subcooled to about 73 F before the heat was released in changing from a liquid to a solid.

Representative cycles of the test period are covered by Figure 3. The table includes the length of each cycle, the kilowatthours of electric resistance heat consumed, the average kilowatt demand and the equivalent Btu per hour. The equivalent Btu/hr

(*Continued on page* 64)

MELTING CYCLES, SALT STORAGE TESTS, KENOVA, WEST VIRGINIA

Representative Cycles During Test Period

DATE	BEGIN	END	LENGTH OF CYCLE HOURS MELTING	LENGTH OF CYCLE HOURS FREEZING	KWHR	KW	BTU/HR
1953							
9/22	7:15 AM	8:30 PM	13.25	12.83	12.9	0.977	3330
9/23	9:20 AM	8:30 PM	11.16	35.16	7.8	0.698	2380
9/25	7:40 AM	8:20 PM	12.67	12.00	11.0	0.876	2990
9/26	8:20 AM	7:30 PM	11.16	11.83	7.5	0.672	2290
10/28	6:00 PM	9:00 PM	3.00		2.5	0.834	2840
10/28	9:00 PM	12:00 MN	3.00		2.4	0.800	2730
10/29	12:00 MN	6:00 AM	6.00		5.5	0.916	3120
10/29	6:00 AM	9:00 AM	3.00	21.50	2.5	0.834	2840
10/29–10/30	9:00 AM	7:35 AM	22.58		15.5	0.704	2400
10/30–10/31	7:35 AM	6:15 PM	34.67		23.9	0.689	2350
12/17							
12/18	9:30 PM	11:00 AM	13.50		13.3	0.986	3360
12/18	11:00 AM	7:30 PM	8.50	50.50	7.7	0.906	3090
12/21	11:00 PM	11:20 AM	12.33		12.0	0.974	3320
12/22	11:20 AM	5:20 PM	6.00	385.00	3.0	0.500	1710
12/22	5:20 PM	9:00 PM	3.67		2.1	0.572	1950

Figure 3

SALT STORAGE TESTS
KENOVA, W. VA.

Figure 4
Sept. 22, 1953—7:15 A.M. to Oct. 4, 1953—7:00 P.M.

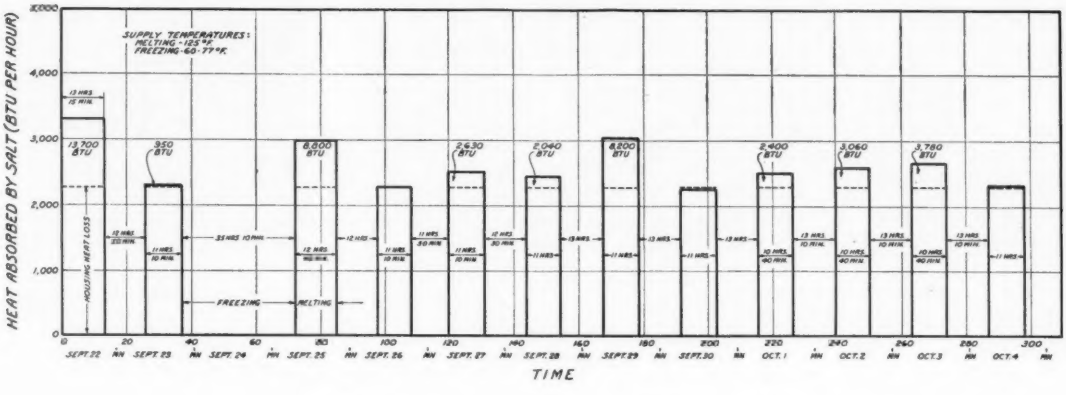


Figure 5
Oct. 26, 1953—8:40 A.M. to Nov. 4, 1953—8:00 P.M.

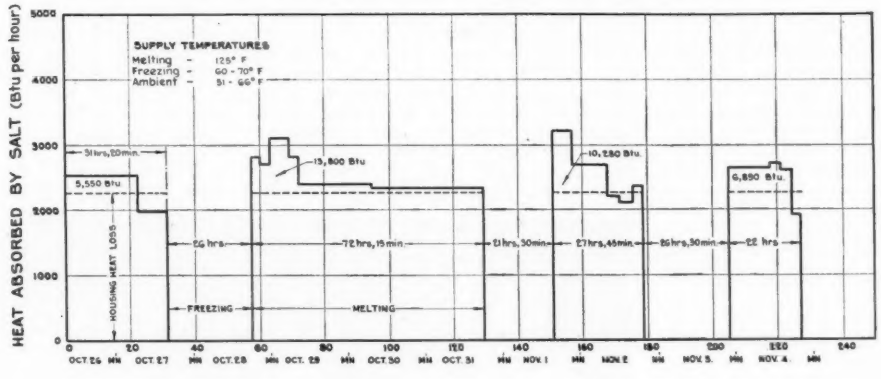
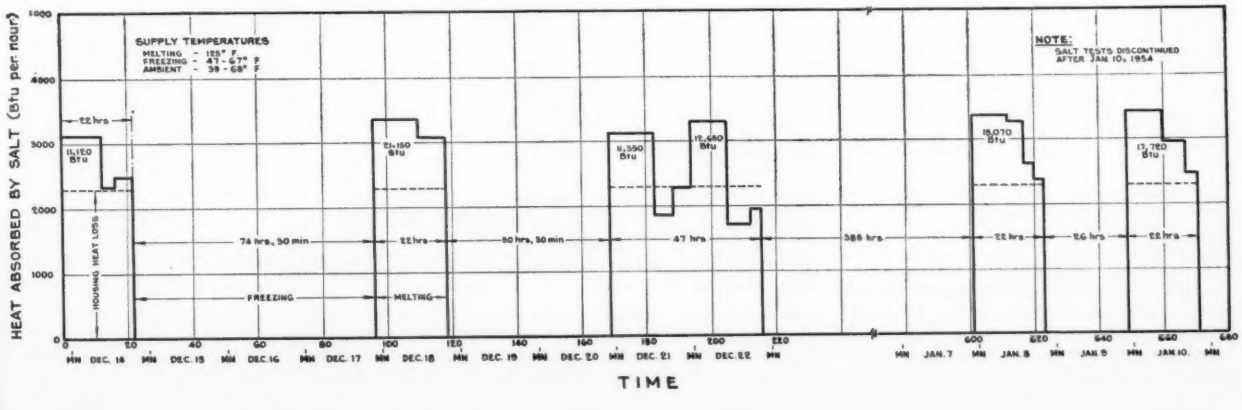


Figure 6
Dec. 13, 1953—9:00 P.M. to Jan. 10, 1954—8:00 P.M.



Resuscitation Cases Reviewed

THREADED through every account of a successful resuscitation of a fellow worker by an electric company employee is the victory of life over death. The workers who save the lives of others often jeopardize their own lives in the process. For their quick thinking and preparedness in saving a life, these men are honored by being presented the EEI Resuscitation Medal.

On the following pages are summaries of resuscitation cases in which EEI Medals were awarded during 1954. As data on additional cases become available, they will be published in the BULLETIN.

RAY C. GOSSETT

Pacific Gas and Electric Company

On the morning of January 8, 1954, a Pacific Gas and Electric Co. crew was completing work on a new 12-kv single-phase tap on Phantom Avenue in San Jose, Calif. Foreman Harlie King noticed that on one pole the bonding wire ran only from cut-out to cut-out and stopped, so he told Lineman George Ranney that it would be necessary to run a new bond out on the arm to include the steel pins. Lineman Ranney and his partner, Lineman Ray C. Gossett, ascended the pole to perform the task.

The two linemen had removed the jumpers from the lines with hot sticks and taken the existing bond down using rubber gloves. As Gossett held one end of the new bonding wire, Ranney held the other and attempted to place the end under the nut of a steel pin which he had already loosened. There was an arc and Ranney cried out, then fell back, unconscious and not breathing, on his safety belt.

Gossett grabbed Ranney, straightened him up, pulled the victim toward him and immediately started to administer Oesterreich Pole Top artificial respiration. Gossett continued the respiration for three to five minutes before the victim started to breathe again.

Meanwhile, Linemen Howard Gaghagen and Mark Cook had run to the accident scene from the point where they were working three spans away. By the time they had climbed the pole, Ranney had been revived, so the three others lowered him to the ground with a bull line.

On the ground, other members of the crew kept the victim covered and treated him for shock while waiting for an ambulance. Within 20 minutes after the accident, Ranney was in a hospital where he was treated for third degree burns. He was able to return to work in three days.

In recognition of the successful resuscitation, the EEI Medal was awarded to Ray C. Gossett, while Certificates of Assistance were authorized for Howard Gaghagen and Mark R. Cook. Presentation of the medal and certificates was made at a special luncheon held in San Jose, Calif., on June 15, 1954.

W. EDWARD HOFFMAN

The Eastern Shore Public Service Company of Maryland

On September 16, 1953, a three-man crew was dispatched by The Eastern Shore Public Service Co. of Maryland to a customer's substation near Georgetown, Del., to install metering current and potential transformers in the 12-kv transformer bus.

When they arrived at the scene, the Eastern Shore Public Service crew was advised that both the transformer bus and the adjacent regulator bus were de-energized. Actually the regulator bus still was energized through a by-pass. The crew did not request that the bus be tested and grounded.

Meter Testers First Class W. Edward Hoffman and Charles P. Rounds had climbed a ladder to the "I" beam on which the transformers were to be installed. Hoffman was fixing a sling for a set of blocks to be used in raising the transformers and Rounds was seated on the beam inching his way backwards towards the center of the beam. There was an arc and a flash as Rounds' shoulder came in contact with the energized bus. Unconscious and not breathing, he slumped backwards on the beam with his left shoulder and part of his body supported by the transformer bus dead end bells. Hoffman immediately went to him, beat out the flames from the victim's burning shirt sleeves and began the application of artificial resuscitation by pressing below Rounds' ribs with one hand while supporting himself with his other hand. Artificial respiration was started approximately 25 seconds after the victim received the shock.

In about two minutes the victim began to breathe and struggled to such an extent that he fell from the beam a distance of 15 feet to the ground. Hoffman followed and applied arm lift-back pressure respiration for approximately five minutes.

Probationary Meter Tester Monroe Whaley was on the ground when the accident had occurred. He ran to his truck and drove to the nearest house to get to a telephone and summon an ambulance from Georgetown. Within 25 minutes after the accident, Rounds was in the hospital where he was treated for severe shock and first, second and third degree burns that covered about 35 per cent of his body surface. He was able to return to work after 109 lost time days.

W. Edward Hoffman was awarded the EEI Medal and Monroe J. Whaley received a Certificate of Assistance in recognition of their resuscitation actions. The award and certificate were presented to the men on March 5, 1954, by George M. Nelson, President of The Eastern Shore Public Service Co. of Maryland. An account of the presentation appeared in the March 6, 1954, issue of the Salisbury *Times*.

NOCE EVANS

Oklahoma Gas and Electric Company

An Oklahoma Gas and Electric Co. crew working in Woodward, Okla., had

Ray C. Gossett (second from left) receives EEI Medal from Raymond W. White, Manager of the Claims and Safety Department, Pacific Gas and Electric Co., as W. R. Bowler, Manager of the company's San Jose Division, and E. N. Britton, Personnel Supervisor of the San Jose Division, look on.

George M. Nelson, President of The Eastern Shore Public Service Co. of Md., presents EEI Medal to W. Edward Hoffman.

Left to right: J. J. Nichols, who accepted Cecil Gay's EEI Medal Miniature; Willis R. Pittman, whose life was saved; EEI Medal winner Clant T. Jones; and H. B. McMahan, Georgia Power & Light Co. Safety Director.

almost completed their work for the day on September 28, 1953. Two of the linemen had finished their tasks and were putting away their tools. Two others, Lineman Apprentice Marlin Jack Bevers and Lineman Noce Evans were still atop a pole replacing a crossarm in preparation for changing a three-phase 4.16 kv circuit from No. 6 copper to 3/0 aluminum.

The crossarm supported three primary phase wires and a series street light wire each of which had been covered with two connecting line hoses. Bevers, who was working on the west side of the pole, had placed one of the primary wires on the new arm between the pole pin and the brace bolt. He then swung his left leg over the secondary neutral, shifted his body until his right leg was on the secondary neutral, and in that position drove a lag screw to fasten the "V" brace to the pole. Evans, working on the south side of the pole, then asked Bevers to reach down and cut the wire holding the S-L transformer while he held it. He lifted the transformer and when Bevers did not cut the wire, he glanced up to see what was wrong. At the same time that he saw Bevers with an agonized look on his face leaning toward the pole, he heard someone yell below. In shifting his position Bevers apparently had pushed the connecting line hose apart with his shoulder and contacted the phase wire.

Evans reached across and tried to push the phase wire away from Bevers but could not break the contact. He instantly decided to cut the No. 6 copper wire, and yelled at everyone below to get clear. As Evans swung around the pole below the secondary rack and started giving pole top resuscitation, Groundman Charles E. Loomis ran to the street to prevent traffic from running into the fallen wire. Evans had positioned himself with the unconscious and not breathing Bevers leaning over one shoulder so that Evans was able to apply pressure on Bevers' abdomen.

Artificial respiration was begun within 30 seconds after the accident, and Bevers began to show signs of life about one minute later. As Bevers regained consciousness, he struggled, so Evans held Bevers' right arm and guided it to the pole, then Bevers grabbed the pole and pulled himself upright in his safety belt. Respiration was continued for another minute before he could breathe without assistance.

Then Foreman Landon W. Rives and Lineman Bob R. Craig mounted the pole and assisted in lowering Bevers to the ground with a set of hand blocks. Assisting by rigging the set of blocks, rendering aid and later helping to get the victim to the hospital were Laborer Elmer D. Chaffin, Truck Driver Keith Fetters, and Lineman's Apprentice Kenneth E. Chapple.

A doctor arrived at the scene within a brief time and removed Bevers to a hospital where he was treated for second and third degree burns. He recovered enough to return to work in 48 days.

An EEI Medal for Noce Evans and Certificates of Assistance for Landon W. Rives, Bob R. Craig, Charles E. Loomis, Elmer D. Chaffin. Keith R. Fetters and Kenneth E. Chapple recognized the successful resuscitation efforts of these men. The awards were presented at a special

Right to left at a Missouri Public Service Co. ceremony are EEI Medal Miniature winners Harold Z. Elwell, Rolla Cox, Truman Henry, Oren Henry, and H. J. Weitzel. Willis Daugherty, far left, received a Certificate of Assistance for his help in saving the life of William L. Thomas on December 30, 1952.

EEI Medal winner John W. Kelly (center) is flanked by Certificate of Assistance winners Robert F. Ragon (left); Harold H. Moore (second from left); T. D. Hayes, Florida Power Corp. Division Manager (right of Kelly); and Roger H. Moses.

Allen Van Wyck (left), President, Illinois Power Co., presents EEI Medal to Logan L. Sanford.

ceremony in Woodward, Okla., and an account of the resuscitation and award authorization appeared in the June issue of the company magazine, *The Meter*.

CLANT T. JONES

Georgia Power and Light Company

A windstorm raging in Bainbridge, Ga., on the morning of September 26, 1953, had torn down electric wires, and a two-man Georgia Power and Light Co. crew was dispatched to Shotwell Street where wires were reported down in the street. When Lineman Cecil L. Gay and Winch Truck Driver Helper Willis R. Pittman arrived at the scene, they found a large tree limb had fallen and torn down two conductors of three-phase primary, the neutral conductor and a series street light conductor.

The two men walked four spans to the pole where the primary fuses were located and found one fuse blown. Gay climbed the pole and removed the three fuse cartridges. Meanwhile, Lineman Clant T. Jones and Groundman Hugh Barwick also had arrived at the scene.

While Gay was climbing another pole, he noticed a small tree limb hanging on the primary further up the street. After removing the limb, he forgot about the street light circuit and again climbed the pole to splice the neutral wire. While Gay was climbing the pole, Jones began to climb a small tree to help pass the wires through. Pittman got wire and splicing sleeves from the truck and told Barwick to help Jones while he helped Gay.

Jones was still climbing the tree when he heard Pittman call him. He looked around and saw Pittman falling with the street light circuit smoking in his right hand. Jones jumped from the tree, got his rubber gloves from his tool belt on the sidewalk and pulled the wire from Pittman's hand. Pittman was lying on his back, unconscious and not breathing, when Jones began the administration of Back Pressure-Arm Lift artificial respiration. Jones continued the procedure for approximately 10 to 15 minutes before there was any sign of breathing. Meanwhile a physician and the fire department had arrived with oxygen. When the doctor gave his approval, the administration of oxygen was begun while artificial respiration was maintained. Jones then asked to be relieved, and Gay took over and continued the artificial respiration for about five more minutes before Pittman was removed to a hospital.

Pittman was treated at the hospital for second and third degree burns of the right hand and lost the terminal phalanx of the right ring finger. He was away from his job for about six and one-half months.

Investigation later revealed that the street light circuit had crossed with a 4160-v primary over a mile away from the accident scene.

An EEI Medal for Clant T. Jones and a Medal Miniature for Cecil L. Gay recognized these men's resuscitation action. The awards were presented at a special dinner held in Bainbridge on July 30, 1954. News items on the resuscitation and award presentation appeared in the August 5 edition of the Bainbridge *Post Searchlight* and in the August edition of the Florida-Georgia *Power Lines*.

HAROLD Z. ELWELL
ROLLA COX
TRUMAN HENRY
OREN M. HENRY
H. J. WEITZEL

Missouri Public Service Company

Apprentice Lineman William Lacey Thomas and another Missouri Public Service Co. lineman had worked all morning on December 30, 1952, on a horizontal beam of the steel substation structure at Warrensburg, Mo. Noon came and the men left their jobs to go to lunch. The other lineman climbed down a 23 ft vertical steel column to the ground, but Thomas started to walk across another horizontal beam, apparently to descend another vertical column. The beam which Thomas chose to cross had three 69,000-v lightning arresters mounted upon it, and, six feet from the vertical column which the other lineman descended, Thomas contacted the first arrester on the beam, creating a phase-to-ground fault on the 69,000-v line. The electric shock and fire of this contact rendered Thomas unconscious and stopped his breathing, causing him to fall the 23 feet to the ground where he landed on a concrete mat.

Apprentice Lineman Harold Z. Elwell immediately started the administration of Schafer Prone method artificial respiration. After about three minutes the victim showed signs of breathing. Elwell was relieved by Line Foreman Rolla Cox, Personnel Director Truman Henry, District Engineer Oren Henry and Chief Engineer H. J. Weitzel who continued to give the victim artificial respiration for about 45 minutes. Meanwhile, Groundman Willis Daugherty had covered him with clothing to preserve his body heat.

Thomas was removed to a hospital where he was found to be suffering from cerebral contusion, cerebrio-spinal fluid pressure, ruptured spleen and second degree burns over 20 per cent of the body. While the resuscitation of Thomas was successful, the injuries he received in the fall and the burns he had suffered proved fatal 10 days later.

For their participation in the resuscitation action, EEI Medal Miniatures were presented to the following: Harold Z. Elwell, Rolla Cox, Truman Henry, Oren M. Henry and H. J. Weitzel. In addition, a Certificate of Assistance was awarded to Willis Daugherty. These awards were presented at a special ceremony held on March 17, 1954, an account of which appeared in the March 31, 1954, issue of the Warrensburg *Daily Star-Journal*.

JOHN W. KELLY

Florida Power Corporation

A packing house, located on North Boulevard near DeLand, Fla., was afire on the night of September 25, 1953, and Florida Power Corp. employees had been summoned to the scene. Located near the corner of the burning building was a pole carrying a 3-phase 4800-delta circuit, three lightning arresters, three 50-amp enclosed fused cutout switches and two transformers that served the packing house and other customers in the vicinity. The pole caught fire and some of the secondary lines burned down.

Since the number of available work-

men at the scene was small and because there was no further need for 3-phase service at the location, it was decided that the transformer bank would be removed and replaced by a single transformer to provide residential service.

The men cut and spliced secondary line going back to the pole so that it would be ready to attach to the pole when the fire abated enough so that a man could work on the transformer pole. Line Foreman Harold H. Moore investigated the pole and reported that the two cutout switch doors on the road side were open and that the cutout switch door on the field side had been so badly damaged that there was a possibility that the line might be hot all the way down to the transformer. Lineman William J. Dreggors then told Moore that he believed the pole was cool enough for him to work on, and Moore went to the truck to get hot line cutters which he gave to Lineman John W. Kelly who was going to hand them to Dreggors when he called for them. Moore then walked about 40 ft to the next pole. Kelly placed the hot line cutters at the foot of the pole then went to race the truck's motor so that lighting would be improved and to move the spotlight down the pole.

Suddenly someone cried out and Moore realized that Dreggors had contacted a hot wire. The contact had been made when Dreggors attempted to cut a 4800-v riser with pliers without using rubber gloves. As Dreggors fell loose backwards in his safety belt, Moore called to the other workmen for aid. Kelly, who had on his hooks, ran from the truck to the pole and climbed up to the unconscious and not breathing victim. He immediately began to give Pole-Top resuscitation to the injured man. Dreggors started to breathe again after about 10 strokes of artificial respiration but the process was continued for about two additional minutes. Meanwhile, Apprentice Lineman Robert F. Ragon had climbed the pole to help hold Dreggors while Kelly administered resuscitation.

Moore called for a handline which Winch Truck-Driver Helper Roger H. Moses secured and took up the pole. The line was then fastened to Dreggors' "D" rings and the victim was lowered to the ground. An ambulance which had been summoned by Moore was at the scene and Dreggors was removed to a hospital for treatment of third degree electrical burns on the fingers and palms of both hands. Later the index finger of his left hand was amputated. Dreggors lost six months from work as a result of his injuries.

An EEI Medal was awarded to John W. Kelly for his successful resuscitation of Dreggors. Other aid to the victim was recognized by Certificates of Assistance which were awarded to Harold H. Moore, Robert F. Ragon and Roger H. Moses. Presentation of the awards was made at a special dinner held in DeLand on June 10, 1954. Stories of the award appeared in the June 10 and 11, 1954, issues of the DeLand *Sun News* and in the June, 1954, issue of *Florida-Georgia Power Lines.*

LOGAN L. SANFORD
Illinois Power Company

At Illinois Power Co.'s Galesburg Powerhouse on October 27, 1953, there was trouble in the Santa Fe Circuit, 4-kv to 6.9-kv delta, 3-phase bank, mounted along one wall of the 33-kv room at the powerhouse, 7 feet above the floor. The bank had been killed and a two-man maintenance team was inspecting and testing to locate the failure.

The men had decided to remove the cover of the center transformer. One of the workmen had climbed a ladder and was working from a small platform in front of the bank and facing a rack out from the bank. The other workman, Substation Electrician John Gross, crawled over one transformer, apparently with the intention of removing the center transformer cover. As he crawled, Gross raised up, and he contacted one bus of 33-kv across the top of his shoulders. When an operator immediately opened the breaker to put out the arc, the unconscious and not-breathing victim pitched forward over two other transformers to the floor, a distance of about 12 feet.

Relay Specialist Logan L. Sanford rushed to Gross and administered artificial respiration by the Arm Lift-Back Pressure method. Resuscitation was continued by Sanford for about four minutes before a physician who had arrived at the scene pronounced Gross' breathing as normal.

The victim was then removed to a hospital where he was treated for severe burns and for scalp lacerations sustained when he was thrown to the floor. Burns on the right foot, where the current left Gross' body, eventually necessitated amputation.

Logan L. Sanford was awarded an EEI Medal for his prompt and effective resuscitation action. Presentation of the medal was made at a dinner on April 9, 1954, by Allen Van Wyck, President, Illinois Power Co. Two newspapers of the area carried accounts of the presentation ceremonies.

Pictured following EEI Medals and Certificate presentation are (left to right) Division Manager R. H. Thompson, victim R. L. Lomas, resuscitators C. E. Grounds, R. F. Miller and F. L. Green, and D. T. Lacey, safety official.

FRANCIS L. GREEN
CHARLES E. GROUNDS
Central Illinois Public Service Company

On September 9, 1953, during the early morning time between 5:00 and 5:55 a.m., Central Illinois Public Service Co. had arranged with its customers to interrupt service on a single-phase tap serving radio station WVKN and two other customers. This arrangement had been made to do some rewiring in preparation for converting the entire circuit from 7200-v delta to 12,000-v wye.

At 5:15 a.m. Lineman Kenneth D. Patterson and Groundman Robert L. Lomas had climbed a pole to work on a transformer installation. Foreman Francis L. Green was standing near the base of the pole. Patterson worked near the top of the 35 ft pole; Lomas was about 15 ft below him.

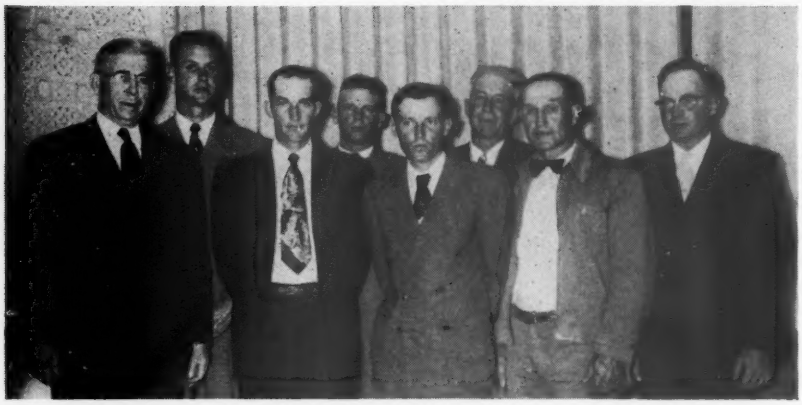
While installing a ground wire extension on the pole, Patterson allowed the loose end of the wire to contact an energized primary conductor, completing a circuit through his body from his right hand to his right knee which was in contact with the grounded secondary conductor. Green saw the flash and looked upward where he saw Patterson slump backward, unconscious and not breathing, in his safety strap. Green called to Lineman Robert F. Miller and Groundman-Truck Driver Charles E. Grounds, who were at work on another pole, to come quickly.

Almost immediately a second flash occurred and Lomas slumped in his safety belt. Lomas had been waiting for Patterson to connect the ground wire. Investigating officials of the company believe that the loose end of the ground wire was swinging and hitting the top of the cutout. When Patterson received his shock, it is believed that Lomas was not in contact with the lower end of the bare wire or at least had not contacted a ground point to complete the circuit. However, when the ground wire hit the cutout a second time, Lomas was in contact with the bare wire and his left shoulder was touching the end of the transformer hanger bolt.

When Green had put on his climbing tools, he hurried up the pole. Because he believed Patterson was the victim in greater danger, he passed Lomas, who was slumped unconscious and not breathing in his safety belt, to get to Patterson. Upon reaching Patterson, Green immediately began to apply Pole Top artificial respiration.

Meanwhile, Miller crawled up the pole to Lomas, and lowered him to the ground by placing the victim astride his safety belt. On the ground, Lomas immediately started receiving Schafer method artificial respiration from Grounds. Miller then reclimbed the pole to assist Green with Patterson.

After four or five minutes of artificial respiration, Patterson started breathing and began to struggle. Green and Miller then began to lower Patterson to the



T. A. Purton (left), Western Colorado's Chief Engineer, presented EEI Medals to R. C. Kettle and David Warner (front, l. to r.) and Certificates of Assistance to Ruben Morris and Glenn Tyler (front, right), Dale Vanderslice, Delbert Sutton, and Herbert Colvin (back, l. to r.) for aid in the respective rescues.

ground with a rope. On their way down, Green instructed Grounds to change to Back Pressure-Arm Lift artificial respiration for Lomas. Lomas began to breathe after about three minutes of artificial respiration, but the procedure was continued for approximately three minutes longer.

Green, Miller and Grounds then kept both victims quiet on the ground until ambulances, previously summoned by neighbors, arrived to take them to a hospital.

At the hospital, Patterson was treated for first, second and third degree burns of the face, neck, hands and legs and for thermal irritation of the right eye. He lost 132 days from work. Lomas suffered first, second and third degree burns of the face, both hands and left shoulder. Amputation of the first finger of each hand proved necessary. Lomas was able to return to work after 105 days.

Since this accident involved two separate resuscitations, two EEI Medals were awarded. Francis L. Green received one of the medals for his successful resuscitation of Patterson; the other went to Charles E. Grounds for his life-saving efforts with Lomas. A Certificate of Assistance recognized the aid rendered by Robert F. Miller in the two resuscitations.

The awards were presented on August 10, 1954, at a meeting of all Central Illinois Public Service employees in Olney.

ROBERT CLAIR KETTLE

The Western Colorado Power Company

On the morning of November 15, 1953, a line crew of The Western Colorado Power Co. had a hot-line maintenance job on the Tacoma-Durango 44-kv line ten miles north of Durango, Colo. Linemen Robert L. Akehurst, Arthur J. Brown and Robert C. Kettle had replaced broken insulators and crossarms on Pole 193 and started removing the wire tongs and saddle clamps from the pole.

Akehurst was near the top of the pole, his left foot resting on the grounded guy wire, his left hand holding a saddle clamp. As he reached for the hand line needed to lower the saddle, the chain attached to the clamp swung, hitting a phase wire. The circuit was completed through Akehurst's body and the shock felled him, his left arm falling across the phase wire, his right foot contacting a saddle clamp and his left leg hanging across the grounded guy. An arc cracked and flashed, stopping when the circuit was de-energized by automatic equipment. Akehurst, unconscious and not breathing, lay tangled in the phase wire and the guy.

Brown and Kettle sprang into action. Brown, who was above Kettle and three feet below Akehurst, climbed above Akehurst and pulled him free of the wires with a mechanical hand given him by Kettle. Kettle, only 20 or 25 seconds after the arc broke, climbed up to Akehurst and started pole-top resuscitation.

On the ground, Foreman Glenn R. Tyler ran to the truck to report the accident on the short-wave radio. Apprentice Lineman Dale Vanderslice, seeing that Tyler was having trouble with the radio, ran to help him and took over so that Tyler could go up the pole to help. Vanderslice got the call through and told the plant to send an ambulance and not to recharge the line.

Tyler took the hand line up the pole so that Akehurst could be lowered. Brown strung the line through the "D" rings on Akehurst's belt, knotting it about ten inches below the victim's chin so that Truck Driver Ruben H. Morris, who was on the ground holding the other end of the line, could help guide Akehurst down the pole. Approximately two minutes after resuscitation was started, when they were about 18 feet from the ground, Akehurst started to breathe and regain consciousness. Kettle continued resuscitation and took short steps down the pole, but with difficulty because the now-conscious Akehurst alternately leaned back against Kettle and then grabbed the pole, pulling away from Kettle. Brown and Tyler kept releasing Akehurst's hold on the pole and pushed him back against Kettle, telling Kettle to "Keep it up; don't stop" with the resuscitation. They also had to help Kettle by putting his hooks against the pole so he could push them in as he descended. Kettle, Brown and Tyler, assisted by Morris on the hand line, got Akehurst down within 15 minutes and laid him on the ground, where Kettle and Brown continued artificial respiration using the arm-lift back-pressure method for a few minutes.

They waited for the ambulance for a short time until word came over the radio that the ambulance was unavailable. They then put Akehurst on the pick-up truck and started for the hospital. About five miles out of Durango they met the ambulance and transferred Akehurst to it. At the hospital he was treated for third degree burns of both feet, his right shoulder and neck and his entire left side, including his left hand and shoulder. The severity of the injuries necessitated amputation of the left leg at the knee and the right leg above the ankle.

Robert C. Kettle was awarded the EEI Medal for his successful resuscitation and Certificates of Assistance were presented to Arthur J. Brown, Glenn R. Tyler, Ruben H. Morris and Dale Vanderslice on April 22, 1954, at the company's Safety Roll of Honor banquet in Silverton, Colo.

DAVID WARNER

The Western Colorado Power Company

A line crew of The Western Colorado Power Co. was adding a crossarm to make a double arm on a pole at the corner of West 9th St. and the Truck Highway in Durango, Colo., on July 22, 1953. It was 4:30 in the afternoon. Working Foreman Henry A. Wilkinson and Lineman James H. Colvin were on the pole. Vehicle Operator Delbert K. Sutton and Apprentice Lineman David Warner were on the ground.

Wilkinson was attempting to replace the eye bolt in the crossarm and had switched his position to facilitate finding the hole in the crossarm. With his right knee in contact with the rod on the street-light fixture he reached for the eye bolt and contacted a 2400-v phase wire with his right elbow, completing the circuit. The shock rendered him unconscious and frozen to the wire.

Colvin, who was working on the other end of the crossarm with his back toward Wilkinson, heard Wilkinson groan. Turning in his belt he saw Wilkinson, who was not breathing, frozen to the wire. He reached over, grabbed the victim's overall suspenders and yanked him free from contact. He yelled to the ground for a hand line which he hooked in Wilkinson's belt and, after unsnapping Wilkinson's safety strap, guided him away from the street-light mast arm and braces as Sutton and Warner lowered him to the ground. On the ground about two minutes after receiving the shock, Wilkinson was placed in position for Schafer prone-pressure artificial respiration. Sutton worked on his neck to restore circulation and relax the muscles and Warner administered resuscitation for about five minutes until Wilkinson was breathing naturally. The ambulance arrived and the victim was rushed to the hospital where he was treated for third-degree burns on his right elbow and right knee. The time lost from work due to the accident was 25 days. No permanent disability was suffered.

For their rescue and life-saving resuscitation, David Warner was presented with the EEI Medal and James H. Colvin and Delbert K. Sutton with Certificates of Assistance by Western Colorado Power's Chief Engineer, T. A. Purton, at the company's Safety Roll of Honor banquet in Silverton, Colo., on April 22, 1954.

CHARLES R. BECK

Duquesne Light Company

In the kitchen of his home at 398 Friday Rd., Pittsburgh, Pa., on January 9, 1954, John Koontz, a welder at the H. J. Heinz Co., was pulling on a galvanized wire attached to a lamp cord in order to snake the lamp cord from the sink top down between the sink and the wall. After pulling through a length of the cord, to which a male plug was attached, he asked his wife to see if enough cord remained above the sink to allow the plug to reach the outlet on the wall above the sink. Mrs. Koontz plugged the cord into the receptacle and Koontz, crouched under the sink with the bare wire in his left hand and his chest against the sink drain pipe, received a 120-v shock. Mrs. Koontz, seeing smoke under the sink, pulled the plug out of the receptacle, releasing the unconscious and apparently not-breathing Koontz from contact.

Koontz's three sons ran to a next-door neighbor, Charles R. Beck, Carpenter Foreman of Duquesne Light Co., and told him what had happened. Beck rushed to the Koontz home to find Koontz on his back on the floor in front of the sink. Turning him over, Beck started Schafer Prone Pressure artificial resuscitation. About two minutes had elapsed between the shock and the start of the artificial respiration. Approximately 25 minutes later Koontz started to gasp and breathe rapidly. Beck continued artificial respiration for another ten minutes or so until Koontz breathed without difficulty. Koontz then struggled to his feet despite the restraining efforts of Beck and mumbled incoherently as he made his way toward the front door of the house.

At this time, in response to Mrs. Koontz's earlier telephone calls, a doctor and some policemen and firemen arrived with an inhalator. They quieted Koontz and he became rational within about 15 minutes. Koontz suffered two burns high on his chest which, as far as is known by Duquesne Light Co., did not cause him to lose any time from work.

Charles R. Beck, for his dramatic rescue, was awarded the EEI Medal and a Duquesne Light Co. check for $50 at a ceremony in the Manchester Shop on October 13, 1954. A story of the award appeared in the November issue of the company house organ, *Public Service*, and in the October 15 *Pittsburgh Sun-Telegraph*.

NATHAN W. SCHRADER

The Montana Power Company

At the Cascade, Mont., substation of The Montana Power Co. on the morning of October 29, 1953, Combination Troubleman Hylon K. Burch was performing his assigned task of drilling two holes in a 6 by 6 in. timber for the installation of a new potential transformer. He had climbed a ladder to reach the timber 10 ft above ground level. Substation transformer bushings opposite the side of the timber where Burch was to drill the holes had been covered. Before drilling, Burch, either to look or to measure on the other side of the timber, placed his right foot or knee on another timber and crawled out further to get more room to look around. As he did so the top of his head touched the bottom of an energized cutout. Thus his head and his left leg, which was against the ground wire, completed a 7200-v circuit through Burch's body.

There was an arc, and Burch, unconscious, fell to the ground. Line Foreman Nathan W. Schrader, who was using a nearby telephone at the time of the accident, and another co-worker, Ben Muri, rushed to Burch, straightened his body and Schrader immediately began to apply Back-Pressure Arm-Lift artificial respiration. Muri ran for other aid while Schrader continued to administer artificial respiration. Burch began to breathe after two minutes and was breathing without difficulty after another two minutes of artificial respiration. He was then removed to a hospital to be treated for shock and electrical burns.

In recognition of his life-saving action, Nathan W. Schrader was awarded an EEI Medal at a presentation ceremony in Great Falls, Mont., on June 17, 1954.

CLIFFORD LEON YATES

Carolina Power & Light Company

Shortly after 4:00 p.m. on October 16, 1953, Lineman Third Class Clarence E. McNair was on a Carolina Power & Light Co. transformer pole at Hamlet, N. C., preparing to install a jumper between a secondary neutral and an old 2300-v phase wire which was to be used as a common neutral. However, at a junction pole two spans away this old phase wire had been tapped to a live 22-kv phase wire which energized it at 13.2 kv to ground. Wearing rubber gloves, McNair started to place a split-bolt connector on the supposedly dead old phase wire, when his left arm above the glove hit the conductor. The 13.2-kv circuit was completed and an arc flashed as the current traveled across McNair's chest to his right hip and through the D ring on his safety belt, which was touching or very near the secondary neutral.

Lineman First Class Clifford L. Yates, on a pole one span away, saw the flash and heard an explosion and, at the same time, saw McNair fall back in his safety belt, clearing himself from contact as he did. In less than a minute, Yates was off his pole and climbing McNair's pole. He reached McNair, whose face was discolored and who was not breathing, and started to administer bear-hug arm-lift artificial respiration about two minutes after McNair received the shock. Within a minute and a half McNair started to breathe and in another minute and a half started to talk to Yates.

Customer Serviceman H. V. Massengill, who was near the pole when the flash occurred, put on his tool belt and climbers and started up the pole after Yates. Sub-Foreman J. W. McLean was about 200 yards away and, upon hearing the arc, rushed over and climbed up after Massengill. As Yates continued artificial respiration, McLean and Massengill secured a hand line and ran it through the D rings on McNair's belt. When the victim was breathing without too much difficulty they lowered him to the ground, where he was put into a waiting ambulance. Yates accompanied McNair to the hospital, administering Schafer Prone Pressure respiration en route. In all, artificial respiration was applied for about 15 minutes.

At the hospital McNair was treated for flash burns on his face, neck and chest, second-degree burns under his arms and third-degree burns on his right thigh. He sustained no permanent disability, but lost ten weeks from work.

For their alertness and successful resuscitation, Clifford L. Yates was awarded the EEI Medal and J. W. McLean and H. V. Massengill Certificates of Assistance at a testimonial dinner in Rockingham, N. C., on November 5, 1954. The story of the rescue and award appeared in the November 5 *Richmond County Journal*, the December issue of the company's house organ, *The Spotlight*, and in Ebasco's January, 1955, leaflet, *New Items in Safety*.

AMERIGO ARGEI

Central Illinois Light Company

A Central Illinois Light Co. line crew had the job of replacing a crossarm on a transformer pole near a farm on Texas Road northeast of Trivoli, Ill., on the afternoon of February 19, 1954. Journeyman Lineman Frank W. Whitmer removed the lightning arrester and the cut-out, leaving the hot wire tap on the primary wire. He untied the neutral wire and laid it on the secondary wires below him and put one length of line hose on the primary, sliding it to a point where it was stopped by the connector. Thus there was bare wire between the connector and the old crossarm. He untied the primary wire and put it on a hook at the top of the pole. He then removed the old crossarm and started to raise the new crossarm to put it on the throughbolt which was about nine inches from the top of the pole, when, it was assumed through later investigation, his right climber cut out and he lost balance. Throwing the crossarm to the ground, he raised his arms, his left hand contacting the 2400-v primary and his right hand hitting the connector on the ground wire running down the pole.

Lineman Amerigo Argei was working on the pole below the secondary rack and below and to the left of Whitmer. Hearing the arc and Whitmer's yell, he looked up to see Whitmer, unconscious and not breathing, fall away from contact and slump over the service wires, his hooks out of the pole. In less than a minute after Whitmer received the shock, Argei had swung around the pole, climbed up under the injured man and started administering pole-top resuscitation. In approximately three minutes Whitmer started to breathe naturally enough so that Argei could stop the resuscitation. In another minute or so Argei had a hand line, which had been sent up by Clifford Johnson, rigged through Whitmer's D rings and the victim was lowered to the ground. Line Foreman Frank Tracy drove Whitmer to a doctor's office in Trivoli, where Whitmer was treated for multiple third-degree burns on both hands. He returned to work to carry out light duties on the next working day.

An EEI Medal and citation was presented to Amerigo Argei for his life-saving action by CILCO President T. A. Schlink at a dinner for all Farmington, Ill., employees of CILCO on October 25, 1954. Stories of the resuscitation and award appeared in the company's November 1 house organ, *Cilco News*, and in the October 28 *Farmington Bugle*.

EEI Sales Conference Program

(*Continued from page* 36)

a talk entitled "The Dollars in Air Conditioning" will be given by B. R. Askew, Manager of the Industrial Power Sales Division, Georgia Power Co. Frank Griesinger, Assistant Treasurer of The Lincoln Electric Co., will discuss "The Leasing of Industrial Equipment" and Dr. Harry B. Osborn, Jr., Technical Director of the Tocco Division, The Ohio Crankshaft Co., will conclude the session with a talk on "Latest Developments in High Frequency, Including Continuous Casting, Ultrasonics and Welding."

AEC Speaker

The afternoon session, to be presided over by Chairman Young, will start with "Radioisotopes—Their Developing Use in Industry," a talk to be given by Dr. Paul C. Aebersold, Director of the Isotopes Division of the U. S. Atomic Energy Commission. Bruce D. Henderson, Vice President of Westinghouse Electric Corp., will speak on "Selling: Art? Science? Or Pure Personality?" and L. P. Fries, Manager of Power Sales, New York State Electric & Gas Corp., will talk on "A Tool That Works." The concluding speaker of the day will be W. M. Shepherd, Vice President of Arkansas Power & Light Co., whose talk will be entitled "It's a Selling Job."

Residential Group

The EEI Residential Group meeting will start on Tuesday morning with opening remarks by H. H. Brenan, Chairman of the EEI Residential Group, after which George L. Lahodny, Chairman of the EEI Market Research Committee, will announce a new booklet on market research and Mrs. Mildred Lessenich, Chairman of the EEI Home Service Committee, will make an announcement of plans for regional home service conferences. The "Need and Value of Coordination at National and Local Levels" will be discussed by Laurence Wray, Editor of *Electrical Merchandising* magazine, and Norman Wicks, Manager of the National Adequate Wiring Bureau, will describe "Effective Local Adequate Wiring Programs." The final speaker of the morning, Donald E. Bootes, Chairman of the EEI Residential Lighting Committee, will talk on "Beauty-Plus."

Afternoon Session

Lead-off speaker in the afternoon session will be George C. Shenk, Project Manager for the United States Steel Corp., whose topic will be "Inter-Industry Coordination, Its Value and Success." R. L. Coe, Chairman of the EEI Residential Promotion Committee, will speak on "Major Appliance Promotions and Thoughts on Value of Promoting Electric Housewares." A feature of the afternoon will be a dramatic presentation by the EEI Dealer Coordination Committee called "Razzle Dazzle." Concluding the meeting will be C. J. Prashaw, Manager of Range and Water Heater Sales of the Frigidaire Division, General Motors Corp., who will talk on "The Future of the Industry."

"Retirement" Will Be a Misnomer for John Burgan

JOHN L. BURGAN has retired as Director of Rural Development of the New York State Electric & Gas Co. after having served the company for over 25 years in various capacities. He has been active in Edison Electric Institute committee work for 20 years and was one of the leading spirits in the organization of the EEI Farm Group. Mr. Burgan will be retained by his company as consultant on rural development matters.

During most of his service with NYSE&G he has been engaged in farm electrification on a statewide basis and has been prominently identified with Cornell University as well as the EEI in farm electrification projects. In addition, he has been instrumental in the preparation and publication of three important farm handbooks and manuals.

Mr. Burgan worked for the Vinton Colliery and Delano Coal Co. in Vintondale, Pa., for 19 years before joining the Pennsylvania Electric Co. at Johnstown, Pa., a former NYSE&G affiliate, in 1929. He served successively as supervisor, division manager and traveling auditor before being transferred to Rochester, N. Y., where he was engaged in customer relations and sales training work. In 1935 he was transferred to NYSE&G in Geneva, N. Y., as securities manager and was placed in charge of rural development in the division a few months later. In 1937 he was made director of rural development on a company-wide basis and moved to Ithaca, N. Y., to be close to Cornell University, where he has been associated with farm programs. When he became director of rural development, his company had 2300 miles of rural lines serving 20,000 farm customers. The company presently has about 18,000 miles of rural lines serving approximately 50,000 NYSE&G farm customers.

JOHN L. BURGAN

Mr. Burgan, in addition to serving the EEI Farm Group and its committees for 17 years, has been an active member of numerous other EEI committees. He is also a member and past president of the New York Farm Electrification Council and is a member of the American Society of Agricultural Engineers, the Empire State Gas and Electric Association, the American Farm Bureau Federation, the New York State Farm Bureau Federation and the New York State Agricultural Society.

His legion of friends are certain that "retirement" is just a meaningless word in John's vocabulary.

EEI-AGA Customer Relations Training Package

A JOINT EEI-AGA Accounting Division committee recently announced that the Customer Relations Training Package released last September for use by utilities has found wide acceptance and approval throughout both the electric and gas industries.

The supply of complete kits and extra supervisor's manuals and employee booklets has been almost exhausted and the EEI-AGA Committee is now estimating future requirements before authorizing additional printings. If an order has not yet been placed for a kit, it would be advantageous for the EEI and AGA to receive such orders now so that all requests can be filled promptly. A few kits are available upon request to EEI for interested companies to study before ordering.

The many complimentary letters received by both EEI and AGA show enthusiastic acceptance of the training kits. Excerpts from a few of those letters follow:

"the most complete and effective thing of its kind ever developed."—From Rochester Gas and Electric Corp.

"excellent material for background of our contact employee training program."—From Pacific Gas and Electric Co.

"We plan . . . to use the entire program as a part of our indoctrination process for customer contact employees."—From Union Electric Co. of Missouri.

"It fills a long felt need. We will use this material . . . as a refresher for existing contact personnel." — From Michigan Consolidated Gas Co.

The kit contains five sound slidefilms, a manual for use by supervisors in the training course and follow-up booklets for employees. Prices of the Training Package for EEI or AGA members are:

First set	$295.00 per set
Next four sets	$275.00 per set
Next five sets	$240.00 per set
Additional sets	$200.00 per set

Meter Reading

(*Continued from page* 50)

tion in addition to the check provided. In mechanical accounting this function is not useful since it is better performed mechanically. However, the check provided at the time of reading may still be desirable. Since the reader must write the numbers in order to do the subtraction, the use of the transcriber appears to rule out the possibility of this type of check. It may be provided, however, in the following way. Instead of providing last month's reading and average consumption as a part of the reader's information, the expected reading is printed. The check then consists of simply comparing the setting of the slides against the expected reading.

"Curbstone" Reading

In a mechanical accounting system this expected reading is as readily provided on the printed tape as the previous reading and consumption. It may be objected that provision of this information would encourage "curbstone" readings. However, any checking method of this type must rely on providing information from which the expected reading is easily derivable and is, therefore, open to the same objection. If this objection is considered to be serious, the policy should be to provide no such information. Furthermore, the machine could be programmed to deliberately falsify a certain number of expected readings each month to see if they were double-checked by readers.

Application of Techniques

In addition to applications in the reading of electric, gas and water meters, the same techniques should prove useful in other fields. For example, the same or similar devices might be used by milk, bakery and other route salesmen.

The investigations leading to the design of the model transcriber here described were supported by The Cleveland Electric Illuminating Co. of Cleveland, Ohio. The author wishes to acknowledge not only this assistance, but also the counsel he has received from Ralph H. Smith of that company and his associates. Further, the author acknowledges the advice received from his colleagues on the staff of Harvard University.

Hubert C. Blackwell

HUBERT C. BLACKWELL, who retired as Chairman of the Board of The Cincinnati Gas & Electric Co. in 1948, died at his home in Walnut Hills, Ohio, on January 18 at the age of 70. A former member of the EEI Board of Directors, he had, in various capacities, served the electric industry with distinction for 42 years.

A native of Montreal, Que., Mr. Blackwell received his early schooling in Cincinnati and was graduated with a mechanical engineering degree from Purdue University in 1902. In 1940 he was honored by Purdue with an honorary Doctor of Engineering degree.

He started his electric industry career as an engineer with the People's Light Co. of Davenport, Iowa, in 1906 and advanced to vice president and general manager of the company. In 1917 he was made vice president and general manager of Kansas City Power and Light Co., serving as such until 1924, when he joined Cincinnati Gas & Electric in the same capacity. In 1926 he became president and general manager of CG&E, retiring in 1945, when he was named chairman of the board. He also served as vice president of The Columbia Engineering Corp. from 1930 to 1944.

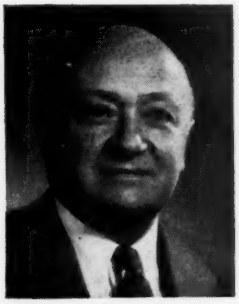
Mr. Blackwell had served on the EEI Operating Committee from 1933 to 1943 and had been a member of the Institute's Board of Directors from 1943 to 1946. He also had served as president of AIEE and had been a member of ASME, AGA, Cincinnati Electrical Association, Engineers Club, Chamber of Commerce, Rotary Club and various other civic and social clubs. He is survived by his widow and two sons, Hugh and Gordon.

A Catalog of EEI Publications

is available upon request to:

Edison Electric Institute
420 Lexington Ave.
New York 17, N. Y.

Personals



C. E. KOHLHEPP

E. H. WERNER

H. P. TAYLOR

Charles E. Kohlhepp, President, Wisconsin Public Service Corp., has resigned to join the General Public Utilities System on April 1 as President of Jersey Central Power & Light Co., succeeding **E. H. Werner,** who will retire on that date. At the same time, **Harold P. Taylor,** Senior Vice President and Treasurer, Wisconsin Public Service Corp., will assume the duties of President of his company.

Mr. Kohlhepp, who has been associated with Wisconsin Public Service Corp. since 1920 and who has been its president since 1948, will also in his new position aid in "developing plans for continued progress and even more effective coordination of both GPU subsidiaries operating in New Jersey, and they in turn with other GPU subsidiaries in Pennsylvania," according to A. F. Tegen, President, General Public Utilities System. Active in business and civic affairs in Milwaukee and Wisconsin, Mr. Kohlhepp is a member of the Board of Directors of Charmin Paper Mills, Wisconsin River Power Co., Wisconsin Valley Improvement Co., First Federal Savings and Loan Association of Milwaukee, and Concordia Fire Insurance Co.

Mr. Werner has been associated with companies now or formerly in the GPU System for the past 40 years. He will live in Florida following his retirement.

A veteran of 30 years' service with Wisconsin Public Service, Mr. Taylor joined the company as division auditor and has since held the positions of assistant treasurer, treasurer, vice president and treasurer, director and senior vice president. He is a member of the EEI Financing and Investor Relations Committee and is currently president of the Wisconsin Utilities Association.

S. L. Muths, Vice President and General Manager, Mississippi Power Co., has assumed the duties of Executive Vice President. Other promotions at Mississippi Power include those of **James S. Eaton,** a member of the law firm which is the company's General Counsel, and **R. M. Shearer,** Commercial Manager, both to be Vice Presidents; **A. J. Watson,** Operating Manager, to be General Manager, and **W. J. Carr,** Assistant Operating Manager, to be Operating Manager.

Mr. Muths has been with the company since its beginning in 1925, was made operating manager in 1935, a director in 1942, a vice president in 1949, and general manager in 1950. He is a graduate of Alabama Polytechnic Institute.

Mr. Eaton, a member of the law firm of Eaton and Cottrell, is the son of Mississippi Power's first president, the late Barney E. Eaton. He is a graduate of Vanderbilt University and the University of Mississippi Law School.

Another continuous employee of the company since it began operations in 1925 is Mr. Shearer, who is a graduate of Bucknell University.

Mr. Watson was named operating manager in 1950. He joined the company in 1930 following his graduation from Mississippi State College.

Mr. Carr, a graduate of Alabama Polytechnic Institute, also has been with the company since its beginning.

George F. Foley, Assistant Secretary and Assistant Treasurer, Florida Power Corp., has been elected a Vice President. Following his graduation from Brown University in 1924, Mr. Foley worked for three years with Hornblower & Weeks, investment bankers. In 1927 he joined Utilities Management Co. where he filled executive positions in many of its associated companies. He formerly was vice president of Kentucky-Tennessee Light & Power Co., and secretary-treasurer of Louisiana Public Utilities Co., Texas General Utilities Co., Tri-Cities Utilities Co. and Owensboro Gas Co.

Robert Brandt, Vice President, New England Power Co., has assumed the vice presidential duties formerly held by **William R. Bell,** who has retired. Mr. Brandt is a former director of Defense Electric Power Administration's Power Supply Division. Mr. Bell, who has been a principal officer of New England Power since 1952, ends a 42-year career with the New England Power System by his retirement.

Lyman H. Hammond, Manager of Domestic and Farm Sales, New York State Electric & Gas Co., has been named Director of Rural Development to succeed **John L. Burgan,** who retired following more than 25 years' service with the company. Mr. Hammond has been engaged in rural work during all of the 20 years during which he has been connected with NYSE&G. He is a veteran of World War I and a graduate of Rensselaer Polytechnic Institute.

Chairman of the EEI Farm Sales Promotion Committee, Mr. Hammond is a member of the American Society of Agricultural Engineers, the advisory committee of the Farm Power and Machinery Division of the Agricultural and Technical Institute at Alfred University and the New York Farm Electrification Council of the New York State College of Agriculture at Cornell University.

J. T. Schilling, Executive Vice President, Iowa Power and Light Co., has been elected President of the Iowa Utilities Association for 1955. He succeeds **Paul L. Mercer,** Union Electric Power Co. Other new officers of the association are **C. P. Conrad,** Iowa-Illinois Gas & Electric Co., First Vice President, and **L. G. Hawkins,** Peoples' Gas & Electric, Second Vice President.

Erwin C. Withers, Head of the Rates & Statistics Department, Monongahela Power Co., has been elected Treasurer to succeed the late **Carl H. Luessow.** Named to Mr. Withers' former position was **Paul E. Davis,** Assistant Treasurer. At the same time, **T. J. Ireland,** Assistant Treasurer, was given the additional duties of Credit Manager.

Since joining the company in 1923, Mr. Withers has held the positions of division engineer, assistant to the president and manager of the Fairmont Division. He had headed the Rates & Statistics Department since 1932. Mr. Withers is a graduate of Marietta College.

Mr. Davis returns to head a department in which he formerly worked for a nine-year period prior to 1949 when he was named an assistant treasurer. Following his graduation from West Virginia University, Mr. Davis did special engineering work with General Electric Co. in Schenectady. He joined Monongahela in 1927.

Mr. Ireland has been an assistant treasurer since 1937 and has been with the company since 1931 when he started as a clerk.

Lester L. Hendrickson, Supervisor of the General Accounting Division, New Jersey Power & Light Co., has been promoted to the newly created position of Chief Accountant. Named to succeed Mr. Hendrickson as Superintendent of the General Accounting Division was **John S. Burchell,** Supervisor of the Accounting Machine Division.

Mr. Hendrickson started his utility career in the Accounting Department of the Metropolitan Edison Co. in 1920. In 1925 he became associated with the North Carolina Power Co. which three years later was absorbed by the Duke Power Co. Mr. Hendrickson joined New Jersey Power & Light Co. in 1935 and became supervisor of the General Accounting Division in 1945. He is a graduate of Pace Institute of Accounting at Washington, D. C.

Since joining the company in 1935 as a clerk in the Residential Sales Division, Mr. Burchell has served in the Payroll Division and the Accounting Department. He was made supervisor of the Accounting Machine Division in 1948. A graduate of Rutgers University, Mr. Burchell has also studied at Stevens Institute of Technology.

Harold Moore, Manager of the Right-of-Way and Land Department, Southern California Edison Co., has been appointed General Sales Manager, a newly created position in the company. Succeeding him as Manager of the Right-of-Way and Land Department is **A. W. Althouse,** Metropolitan Division Manager.

Other new appointments at Southern California Edison include those of **Howard Hayes,** Advertising Manager, to be Manager of the Redlands District; **G. R. Haysel,** Assistant Advertising Manager, to be Advertising Manager; **T. L. Van Law,** Assistant Sales Manager, to be Manager of Industrial and Commercial Sales, and **J. C. Meserve,** Manager of the Huntington Park District, to be Manager of Residential Sales.

Mr. Moore, who assumed his department head duties in 1948, joined Southern California Edison in 1925. Since 1919, when he joined the company as a bookkeeper, Mr. Althouse has served as office manager, assistant merchandise manager, district manager, assistant commercial manager and division manager.

Advertising manager since 1942, Mr. Hayes became first associated with the Southern California Edison in 1928. Prior to that date he had been employed by a number of newspapers in the South. Mr. Haysel has been in the advertising department since 1947 when he joined the company and has filled the post of assistant advertising manager since 1950.

Mr. Van Law has been with the company for 27 years and was manager of industrial sales before he assumed the post of assistant sales manager in 1950.

Manager of the Huntington Park District since 1953, Mr. Meserve was employed by the company in 1928.

Stuart L. Hilyard, Chief Electrical Engineer, Illinois Power Co., has been named Assistant Vice President to head a newly created department that will follow developments in generation of electric energy by atomic energy. Appointed as new Chief Electrical Engineer is **Theodore W. Schroeder,** Assistant Chief Electrical Engineer.

Executive changes which have been announced by Philadelphia Electric Co. include those of **W. H. Jones,** Purchasing Agent, as Manager of Purchasing and Service Operations, and **Milton I. Allen,** Marketing Assistant to the Vice President, as General Sales Manager.

Other new appointments are those of **Philip M. Alden** as Sales Manager, Residential Department; **Austin Monty** as Sales Consultant; **Frank E. Cheney** as Manager of Merchandise Sales; **Maxwell Cole** as Assistant Sales Manager, Industrial and Retail Department; **Frank C. Shermer** as Manager of Market Studies and Service Division; **Charles C. Shotwell** as Manager, Industrial Engineering Division; **Arnold D. Spillman** as Assistant Manager, Market Studies and Service Division, and **Albert G. Garrigues** as Manager, Retail Division.

Mr. Jones, a graduate of Cornell University, was employed by the company in 1926 as an engineering assistant and has since served as gas superintendent, electric superintendent and division superintendent in the company's suburban divisions.

Employed by Philadelphia Electric in 1928, Mr. Allen has spent his career in sales work and was instrumental in the creation of the company's Industrial and Commercial Development Division of the Sales Department. He is a graduate of Pennsylvania State College.

Earl H. Parrish, Operating Engineer, has been appointed General Superintendent of Power Stations, Duquesne Light Co. He succeeds **Thomas E. Purcell,** who has retired after 30 years' service. Following his graduation from the University of Tennessee in 1926, Mr. Parrish joined the company as a test engineer. Other positions he has held at Duquesne include boiler operating foreman at Brunot Island Power Station, station operating engineer at James H. Reed Power Station and boiler engineer and chief engineer at Phillips Power Station.

Howard G. Carter, Superintendent of Light and Power of Puget Sound Power & Light Co.'s Western Division, has been appointed Assistant to the Operating Manager. Named to succeed him in his former position was **Wallace W. Quistorff**, Assistant Superintendent of Light and Power of the Central Division. Another new appointment at Puget is that of **Clarence Scheyer**, Industrial Sales Director, as General Sales Manager.

Prior to his promotion to Superintendent of Operations in the Western Division in 1947, Mr. Carter had held several intermediate positions since joining the company 18 years ago as a clerk in the Engineering Department. Before joining Puget Power, he studied at the Texas College of Mines and had worked at various jobs in Texas, Washington and Alaska.

Mr. Quistorff joined the company in 1928 following his graduation from the University of Washington. He has been employed continuously in the Distribution and Operating Departments and has been assistant superintendent at Ranton since 1939.

Mr. Scheyer has 31 years experience with the company and has worked in service, stores and every type of sales assignment—merchandise lighting, commercial and industrial. In 1942 he was named supervisor of industrial rates and contracts in the vice president's office. Later he became a consultant for officials of Puget's large power consumers. As general sales manager, he will retain this assignment and also will supervise the Dealer Department now being organized.

Harold T. Barrows, Assistant Superintendent of The Hartford Electric Light Co.'s Middletown Generating Station, has assumed the duties of Superintendent of that station, succeeding **Fred L. Gibson**, who has retired.

Mr. Barrows, who has been assistant superintendent of the plant since last May, joined the company in 1915 after employment with Brooklyn Edison Co. and United Electric Light Co., Springfield, Mass. His entire service with the company has been in its power production department, in station operations and maintenance.

Mr. Gibson's retirement comes after 47 years of service. He joined the company in 1907 in its production department and was the first man to be employed as an oiler at the Dutch Point Plant, Hartford. The succession of jobs he has held with the company include those of engineer, assistant foreman of turbine repair, maintenance foreman at the South Meadow Plant, and superintendent of the Dutch Point Plant.

Report on Chemical Heat Storage

(*Continued from page* 52)

represents the amount of heat required to melt the salt and to offset the heat losses from the test chamber.

The heat loss of the test chamber was determined and found to be equivalent to 2295 Btu/hr. This figure was used in all calculations to determine the storage effect of the salt. The amount of heat stored by the salt is equal to the difference between the total kilowatthours consumed and the test chamber heat loss multiplied by the cycle time in hours.

Heat Requirements

The total net weight of salt in the 468 containers was 158 lb. With the heat of fusion of the chemical being 114 Btu/lb, a storage capacity of 18,012 Btu can be expected when the salt is fully effective. The amount of heat required for each of the melting cycles during the test periods is shown on Figures 4, 5, and 6. The values given represent the net amount of heat required to melt the salt (the total delivered heat minus the test chamber heat loss).

The container supply temperature, during the different tests, ranged from 105 F to 125 F for the melting cycle and from 47 F to 77 F for the freezing cycle, but was held constant during any one cycle. The time of the cycle varied from 8 to 72 hours for melting and from 12 to 74 hours for freezing. It can be noticed that the expected storage effect was not realized until the freezing cycle was extended to about 24 hours and the freezing supply temperature reduced to about 50 F.

More Investigation Needed

Additional investigation is needed to determine the limitations and dependability of this salt. The use of this particular salt would be limited if melting temperature of 125 F and a freezing cycle temperature of 50 F are needed for most effective storage capacity. This test did show progress over the previous tests in that satisfactory performance was attained with air as the transfer medium.

History of Lamp Bulbs Recently Published

"LAMPS for a Brighter America" is the title of a recent book covering the 75-year history of lamp bulbs since Edison's invention of the incandescent lamp. The book was written by Paul W. Keating, who has spent 20 years writing about all aspects of the lighting field. His work has brought him in close contact with lighting manufacturers, utility companies and trade associations, including Edison Electric Institute and Better Light Better Sight Bureau.

The book covers the various lamp inventions prior to Edison's work, gives a concise account of his achievements and describes the progress of the many scientists who took up the development of the incandescent lamp after Edison. The parallel growth of the General Electric Co. with the lamp industry is highlighted. Also covered is the broad range of products developed and produced by G.E., many of which are not familiar to the public. The author takes up many of the legal problems that were met in the development of lamps, discusses the economics of the business as related to consumers and the entire lighting trade and reveals important facts about the future progress of the lighting industry.

Priced at $4.00, "Lamps for a Brighter America" is published by the McGraw-Hill Book Co.

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